POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

TECHNOLOGY DEPT.
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OCT 11 1944
DETROIT

Harvey Couch Station In Arkansas
Refrigeration At U. S. Naval Depot, Bayonne
3-Phase Grounded Neutral System
A Look At The Nation's Coal Pile
Unit No. 7 At Fisk Station

For Other Articles See Contents Page 5

OCTOBER
1944

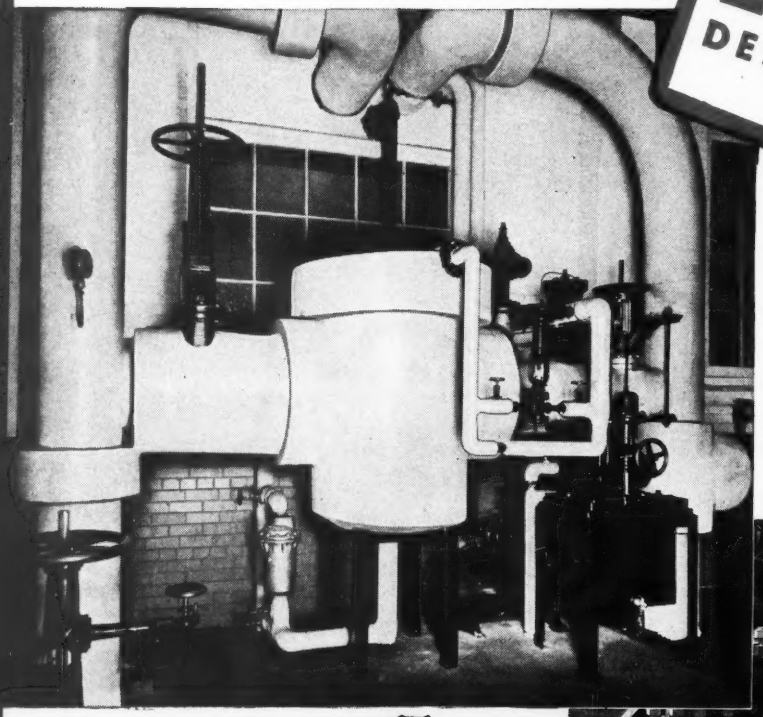
2 services vital to

Taking superheat out of steam . . .

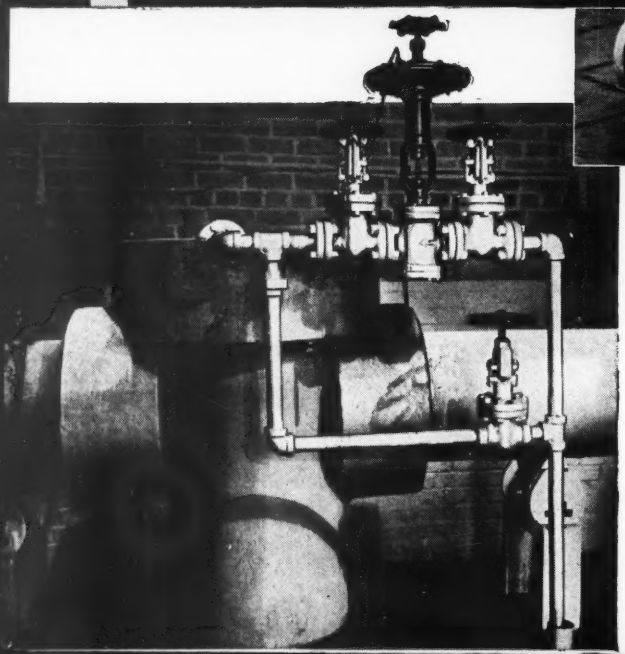
ELLIOTT

DESUPERHEATERS

IN A TEXTILE MILL, this 20-in. Elliott cartridge type desuperheater takes superheated steam extracted from the turbine of a turbine-generator unit removes the superheat, and delivers the steam for process and for plant heating. This desuperheater is rated at 62,000 lb. of steam per hour, 30 lb. pressure, 575 deg. F. in and 335 deg. F. out. Photo shows unit complete with reducing valve, pressure regulator and temperature control.



IN MARINE POWER PLANTS, these Elliott desuperheaters will serve oil tankers, reducing steam temperature in lines adjacent to highly volatile petroleum products. This reduction is from 700 to about 500 deg. F., well below flash point of the tanker's cargo.



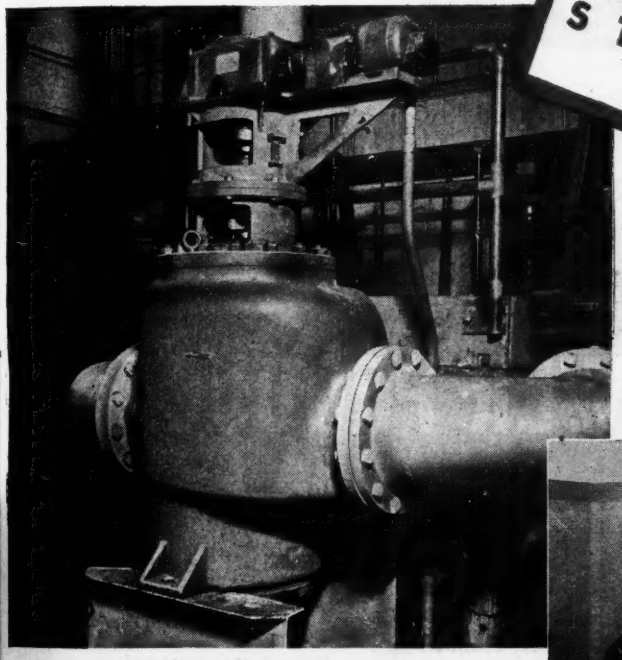
CLOSE-UP OF ELLIOTT DESUPERHEATER in power plant service, showing pressure regulator, and illustrating the compactness of the typical installation. Elliott engineers, expert in desuperheating, are glad to discuss your problem.

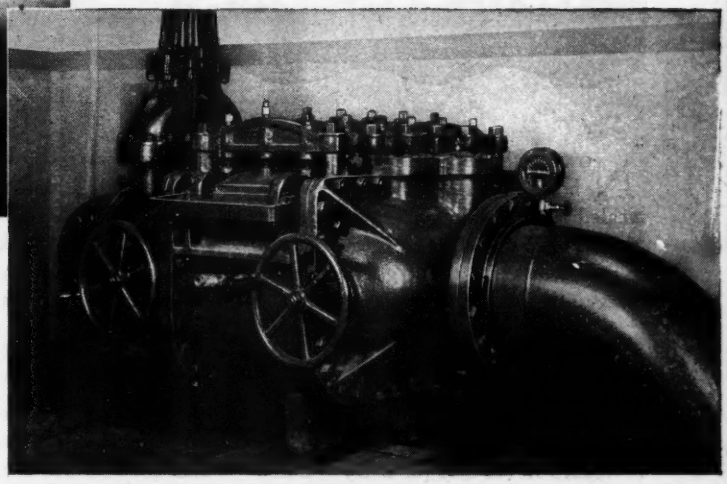
TECHNOLOGY DEPT.

power plant operation

IN PHILADELPHIA ELECTRIC COMPANY'S CHESTER STATION, this 16-in. Elliott self-cleaning strainer clears water for cooling bearings. A small proportion of the incoming water is used to back-flush strainer sections blanked off in turn, taking out foreign substances and restoring the section to duty again. These units have been eminently successful in very many installations giving non-stop service with practically no maintenance.

Taking solids out of service water - ELLIOTT STRAINERS





IN A PUBLIC UTILITY STATION, this Elliott 16-in. twin strainer gives constant service. The only attention required is occasional shifting of the straining load from a fouled cylinder to its clean twin. The fouled basket is then removed and dumped. Thousands of these strainers in all sizes, as well as single strainers of equally sturdy design, have built for Elliott the reputation of "Strainer Headquarters." If you have a strainer problem, let us talk it over.

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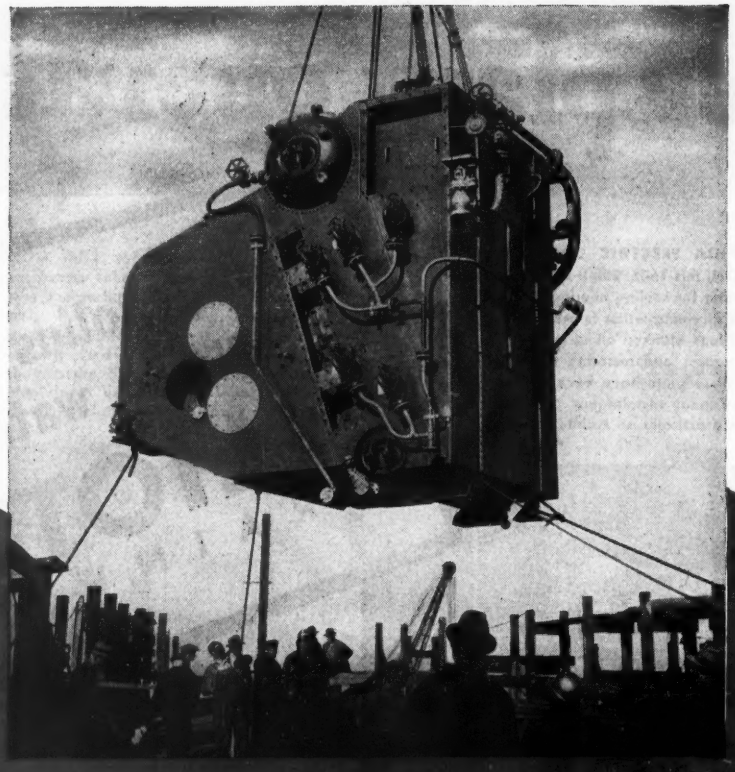

New Sea-Going POWER PRODUCER

Now off the secret list, 30-ton steam boilers of this new type are revealed as powering important units of the Navy's anti-sub fleet. In each vessel, two boilers team up to generate high-pressure steam for the turbine drive.

Efficient steam turbine operation whether on land or sea depends in large measure on efficient lubrication . . . the kind you get with *Texaco Regal Oils (R & O).*

Texaco Regal Oils (R & O) — a new high in preventing rust and oxidation — keep steam turbine systems clean, bearing temperatures normal, governor action smooth and sensitive. These oils free themselves rapidly from air and water, are highly resistant to gum formation and sludging.

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REG. T.M.

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FOR ALL TURBINES

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Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

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By subscription only.
One year $2.00; two years $3.00; three years $4.00 in the United States and Possessions.

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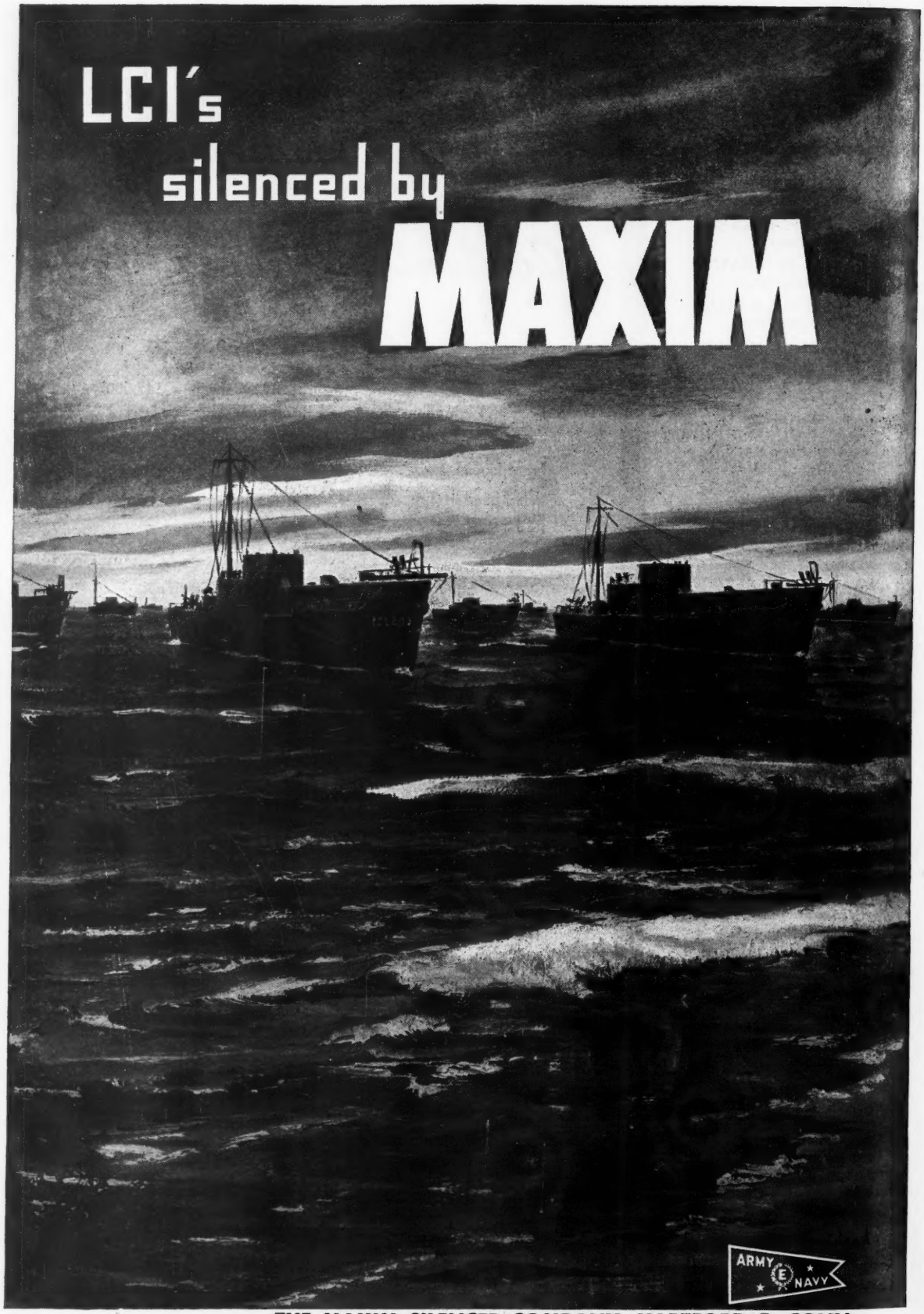
Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

Copyright 1944, by Technical Publishing Co.

Published monthly by the Technical Publishing Co., at 53 West Jackson Blvd., Chicago 4, Ill., U. S. A. Subscription price, $2.00 a year. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. XLVIII, No. 10.



THE MAXIM SILENCER COMPANY, HARTFORD 5, CONN.....

FRONT LINES

DEPARTMENT OF LIBERAL EDUCATION in the House Organs in 15 Minutes a Day!—Oil Is Made to Bounce, well illustrated story of how the new butadiene plant at Port Neches went "on stream" in time for the invasion; Freeze It and Keep It, a story of the quick freeze and locker storage industry; also a most annoying brain-tangler in the problem department headed Mentalnastics; The Power Specialist, July-August, 1944; Johns-Manville * * * Petroleum Refining Developments for War Needs by Gustav Egloff, illustrated with many flow diagrams of the fundamental processes; Valve World, July, 1944; Crane Co. * * * Tactics Tailor-Made, an illustrated account of the work at The Army Air Force Tactical Center at Orlando, Fla.; Doing Fine,—Thank Upjohn, describing how pills, penicillin and blood serum are produced; Wings for Johnny Citizen, how you are going to fly "private" some day; Shell Progress, July-August, 1944; Shell Oil Co., Inc.

REMEMBER that old 1912 Cadillac automobile engine with the copper water jacket? Many engineers have said that was one of the best engines ever made. Well, copper-jacket air-cooling for internal combustion engines is a development you may see more of. Copper jacketing apparently has something to do with producing more even heat dissipation from the cylinder walls. Harry Sparkes, an old racing-car enthusiast, has been working on it for years and has now succeeded in welding a copper jacket to an engine cylinder. A Sparkes engine was reported to be in production by David O. Woodbury in Collier's. It was for military use but Sparkes promises a vertical pancake automobile engine for streamlining into the front cowling operating at high temperature and efficiency and a 50-lb electric generator set to be used for camping, driving a small boat through an electric motor, etc. The Sparkes method may also be useful in cooling brake shoes.

"NO MACHINE has ever been produced that can equal the direct acting steam pump in the essential qualities of flexibility, simplicity, reliability and low cost." That statement, credited to a prominent hydraulic engineer, introduces a fine paper on Direct Acting Steam Pumps by Darwin F. Schaub included in the Engineering Papers, 4th Annual Contest, just published by the Hydraulic Institute, 90 West Street, New York 6. The papers also include Special Operating Conditions of Centrifugal Pumps by A. J. Stepanoff; A Common Language for Hydraulic Engineers by Chas. J. Tullo; Critical Speed by Alexander Brkich; Effect of Entrained or Dissolved Gas on Rotary Pump Performance by Morgan B. Sennett.

THE DANGER that the human race may some day be engulfed and extinguished in a sea of little pieces of paper with figures on them (most of which mean nothing) has often been mentioned here. But it appears a little more remote since the recent paper salvage drive. The New York Herald reports that the New York Central Railroad went through its "dead" files (an art in itself, determining when a file is "dead") and cast 139 tons of out-dated correspondence from it into the paper drive. Leave us all go and do likewise! as Archie would say, so that nobody won't bandage our name.

A SUBSTITUTE for structural steel columns that is stronger and cheaper than steel, as light as aluminum and composed chiefly of concrete, has been tested successfully at the Northwestern Technological Institute, it has been announced by the Institute. The substitute is the idea of Professor George A. Maney, chairman of the department of civil engineering, and was developed under his direction as a part of the War Production Board's research program to discover new materials and designs to reduce the use of scarce materials. Maurice Lagaard, assistant professor of civil engineering, conducted the tests and designed a proposed plant for mass production. The unit, for use in construction of buildings, bridges and special foundations, is composed of highly compressed concrete stronger than any produced heretofore, encased in a spiral of steel wiring. It is estimated that it can be produced at about one-third the cost of steel. Maney said that the column, by reducing the need for steel in building construction, can conserve the United States' natural resources of iron ore, and may prove extremely valuable as a building material in the reconstruction of wartorn areas where steel is scarce. The French Committee for the Restoration of France has expressed strong interest in the invention. The unprecedented strength of the concrete was obtained by compressing the concrete and reducing the amount of water used in mixing it. Only one gallon of water per sack of cement was used, compared to 5 to 8 gal in ordinary concrete. The reduction of water was made possible through a special method of compaction which includes vibrating the concrete while it is damp. One test model of the column, which in actual building construction will be 8 to 10 ft long, is 1 ft long and about 5 in. in diameter. The concrete core withstood 83,000 psi, compared with the 60,000 psi maximum of a solid steel column of identical size. The column is constructed by placing a thin metal lining inside a spiral of steel wire and filling this with the specially compacted concrete. A steel plunger is used to compress the concrete from one end until it is firm. This initial compression—10,000 to 20,000 psi—is a main source of the unit's great strength in that it contributes to the strength of the concrete and at the same time puts the steel spiral under tension which is maintained by the concrete when it hardens.

WOULD YOU REACH for the Bromo-Seltzer if you saw a steam locomotive puffing down the track with a pantograph collector raised overhead to contact a trolley wire and no coal in the tender? Hadn't the guy better make up his mind? Well, in Switzerland, if you were there, you might see a couple of such strange gimmicks. They are regular steam locomotives for which the steam is generated in electric steam evaporators draining power from the trolley wire. These evaporators were installed beside the regular boiler; the two could generate in combination if desired. The answer? The Swiss have beaucoup electric power from hydroelectric plants but, during the war, materials and coal were hard to get. Hence, the electric steam locomotive. They were so successful, reports the Locomotive, that others may be converted.

AUTOMOTIVE ENGINEERS now are too busy with the production of war material to bother with advanced designs. Immediate post-war demand will be for modified 1942 models—in a hurry. The public accepts revolutionary automotive engineering and design slowly and in mild doses. Any automobile even bordering upon the revolutionary must be a post-post-war model, said Brooks Stevens, industrial designer, of Milwaukee, Wis., before a recent SAE meeting. That's the story being dinned into the ears of America these days. We wonder how much fear there is in it—fear that while all the old established automobile builders are preparing to build 1942 models, some production genius, who never was in the automobile business before, and has no dead hand of invested capital and tradition upon him, will find that the cheapest and quickest way for him to build a new type car will be to use the new knowledge of the plastics, petroleum, chemical and aviation industries, and start right from scratch? The automobile industry is always talking about the "sound" designs of the 1930-40 period. But many engineers outside the industry don't agree that automobile design is "sound." They say most of it is based on "salesman's" engineering rather than on "engineer's" engineering. As evidence, they cite Mr. Stevens' remark that the "gold-fish" bowl body is out because the wife prone to dent fenders couldn't get the marks removed before her husband discovered them. They say that the country has been engineering-minded and quality-minded for war so long that it is going to laugh at many of the sales arguments it formerly accepted. We don't know, but—could be. It's important because the automobile, for better or worse, has been woven into the fabric of both our business and social lives.

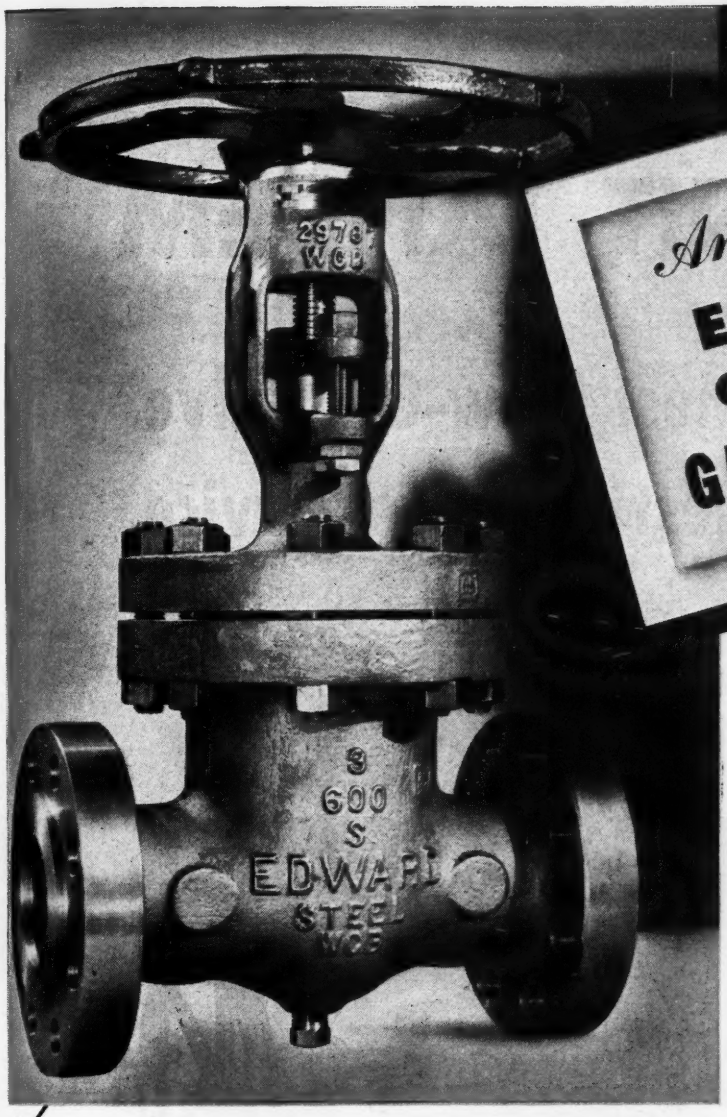
AFTER A COAL MINE has been stripped of the coal that may be obtained economically, the mine may still have great value, as Russia has demonstrated. In Russia, avers The Ohmite News, these mines are set on fire and the gas produced by the incomplete combustion is mixed with steam to manufacture producer gas, which is used for industrial processes and heating purposes.

SPEAKING of the post-war refrigerator, as we were in August Front Lines, have you seen the new ideas for drawer-type refrigerators? This type has been used quite successfully on small yachts where space is at a premium. It lends itself well to an idea for a complete kitchen unit, as described in detail in an article Trends in Modern Refrigerator Design by James J. Corey in the August issue of Refrigerating Engineering. Such kitchen improvements may well be, as Frank Lloyd Wright has pointed out (See Front Lines, August), about all we will get in housing developments for some time, despite the tremendous need for improved housing over the entire country.

MOTORS FOR heavy caliber rocket shells of the new type used on Allied invasion barges have been in secret assembly line production for several months in the Detroit plant of Nash-Kelvinator. The deadly jet-propelled rockets, dubbed "super-bazookas," are mounted on landing barges and provide a fierce concentration of fire power used to shell enemy shore installations. The new rockets are much larger than the earlier "bazooka" projectile used so effectively by Allied troops as tank busters. Nash-Kelvinator's war production program also includes 2000-hp two-stage supercharged Pratt & Whitney engines, Hamilton standard hydromatic propellers, propeller governors, and parts for jeeps, trucks, submarines and ships. The company is also readying facilities for the production of Sikorsky R-6 helicopters.

WHEN YOU ask yourself how we are going to provide post-war jobs for eight or ten million more people than in 1939 or 1940, in face of the fact that both industry and agriculture can produce more with fewer man-hours, look again with a very suspicious eye at all the statistics. (You already know what we think they are one of the three forms of.) Everybody talking about employment after the war seems to be giving the impression that the additional jobs should be in industry—in production. But how can this be if they're not needed? It can't be. But there will be a place where they are needed—in the service industries, that accelerate the consumption of the things we can produce so copiously and efficiently. While there will be some entirely new production industries—plastics or synthetic rubber, for example—the field for new service industries will be tremendous. New laundries, gasoline service stations, hotels, restaurants, electrical shops, radio service shops, photographic shops by the thousands are what we really need, not more factory hands to make more laundry equipment or more radios. Let's get out of our heads right now the idea that we must convert our war factories all to peace production in order to have jobs enough to go around. Sure, for prosperity we ought to have a total of fifty or fifty-five million people employed. But by what divine decree do they have to be employed in production? Is not a housewife keeping a home valuable to society? Isn't she employed? Where did we get this idea that there is something sacred about a "producer," something parasitic about a professor or an orchestra conductor? Horse-feathers! Fisher and Clark, economists, can prove to you that in the most advanced and civilized economies, the proportion of people in the service industries increases at the expense of both farming and industry. So look again carefully at the statistics and stop worrying about how those fifty-five million jobs are going to be found in industry. They're not; anybody who tells you that by proper planning they can be made available is, to put it very mildly, heading towards a dangerous conclusion. But they can be provided if we remember that the products of industry must be used up.

DON'T LOOK NOW—but soon you may be looking at photographic prints that are not images in black and white but images in terms of polarization of light, the result being an impression of depth in three dimensions unobtainable by other means. The picture is called a vectograph. Stereoscopy was an attempt to reproduce depth as felt by human vision. It was revived early in the war for military training and photographic purposes but when the scientists really got to work on it they developed many new angles. E. H. Land developed a polarizer that has revitalized the stereoscopic field. Pictures are projected by polarized light in such a way that there are two pictures in the same place at the same time without interference. The vectograph can be projected by ordinary projection equipment and can be printed. Its value in illustrating mechanisms, giving a third-dimensional depth, should be great. In future teaching of technical subjects, whether in the classroom or in technical books and magazines, you will probably see more of it in the future. Those who heard John T. Rule, Chairman of the Section of Graphics of Massachusetts Institute of Technology, discuss the subject and demonstrate his vectograph slides at the June, 1944 ASME meeting in Pittsburgh will tell you that here is a development of the highest importance to engineering education.



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YOUR POST-WAR GATE VALVE IS READY . . . !

HERE is a valve that *is* tighter and *stays* tighter than you thought a gate valve could—a post-war valve development ready *now!*

Forty years a producer of steel valves for difficult operating conditions, Edward is now building cast steel gate valves for the first time. These valves are available in many sizes and pressure classes for *immediate shipment!*

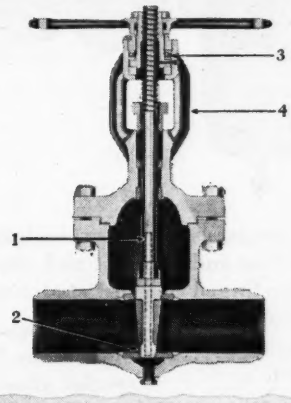
Flow is straight through and unobstructed, yet globe valve tightness is achieved through fundamental differences in design. Specially developed testing methods prevent any Edward gate valve passing test unless *both* faces, *not just one,* are absolutely drop tight *simultaneously.*

NEW CATALOG READY

Just off the press! Catalog 12-E1 with illustrations, dimensions and descriptions of Edward cast steel gate valves for 150 to 3600 lb service. Write for your copy.

✓ *Check These* UNUSUAL FEATURES

1. Close fitting wedge guides welded to body *after* seat rings and wedge are located to assure perfect alignment and eliminate unnecessary wear-producing drag of wedge across seating faces.
2. Perfectly positioned hard surfaced seats, integral with body.
3. Simple yoke construction with ball bearing operation even in medium sizes, EValized surfaces where abrasion is a problem, and no superfluous parts.
4. One piece bonnet for absolute alignment, easy operation, minimized maintenance.

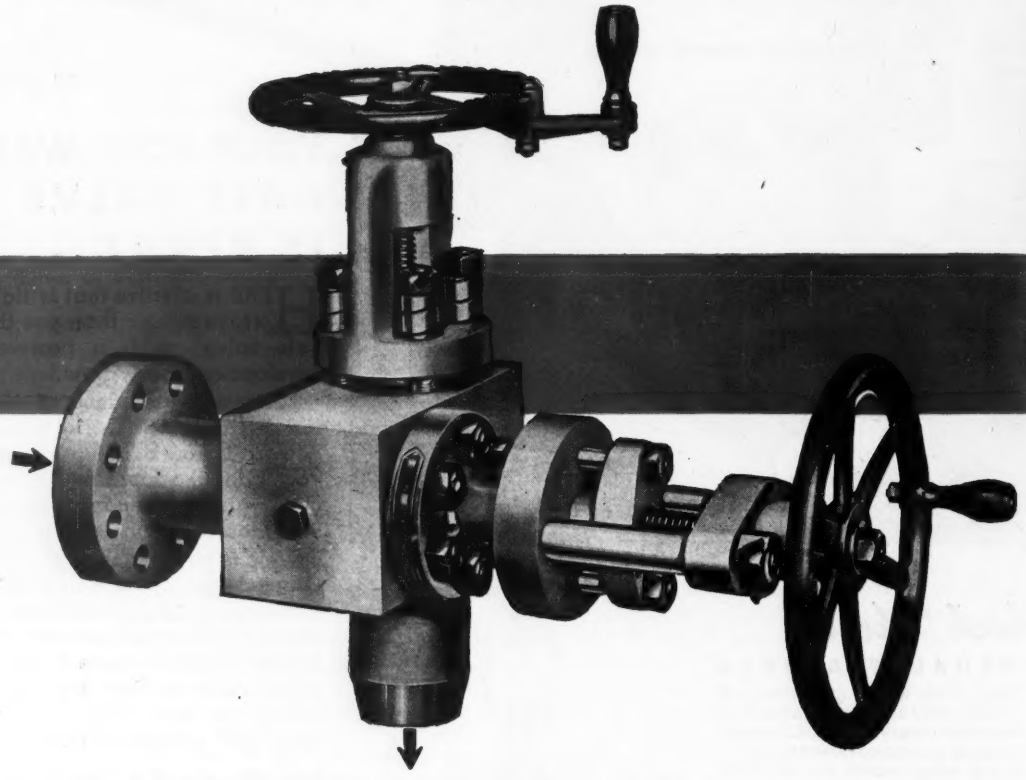


THE EDWARD VALVE & MFG. CO. INC., EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

THE UNIT TANDEM

Yarway's Finest Blow-Off Valve for the Highest Pressure Service

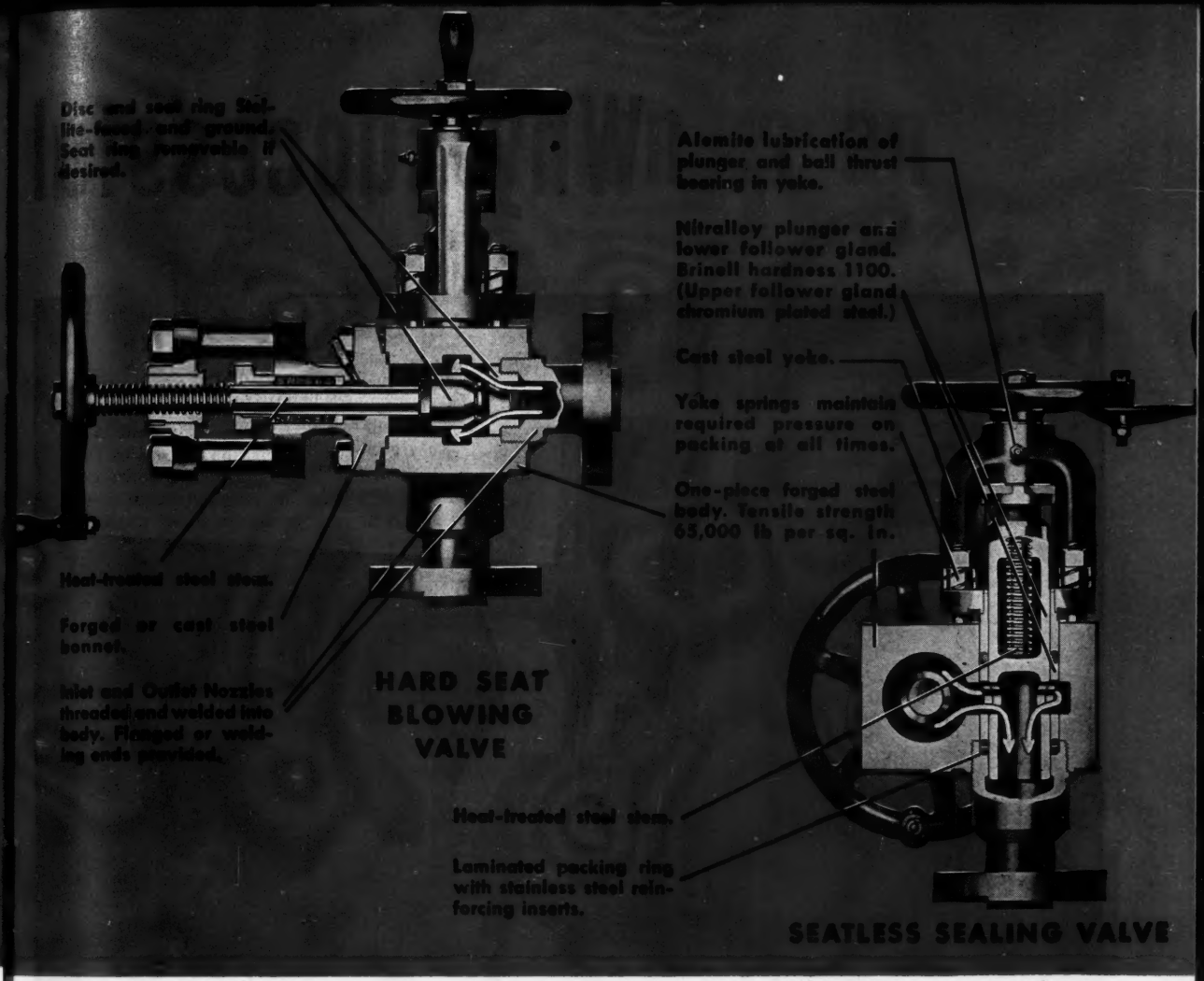


Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs — for blowing and for sealing — in a compact, rugged unit.

Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last, maintaining a tight seal at all times.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special alloys and unique construction features to reduce materially normal wear in this type of valve.

YARWAY


Disc and seat ring Stellite-faced and ground. Seat ring removable if desired.
Heat-treated steel stem.
Forged or cast steel bonnet.
Inlet and Outlet Nozzles threaded and welded into body. Flanged or welding ends provided.
HARD SEAT BLOWING VALVE
Alemite lubrication of plunger and ball thrust bearing in yoke.
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Cast steel yoke.
Yoke springs maintain required pressure on packing at all times.
One-piece forged steel body. Tensile strength 65,000 lb per sq. in.
Heat-treated steel stem.
Laminated packing ring with stainless steel reinforcing inserts.
SEATLESS SEALING VALVE

A Quarter Century of Product Development

Years of service in the high pressure plants of leading Utilities and Industrials have proved the soundness of design and metallurgy of the Yarway Unit Tandem.

Such records as—"3000 blows at more than 1300 lb pressure, without replacement of a single part or repairs of any nature"—have made this Tandem the outstanding preference for high pressure service, today.

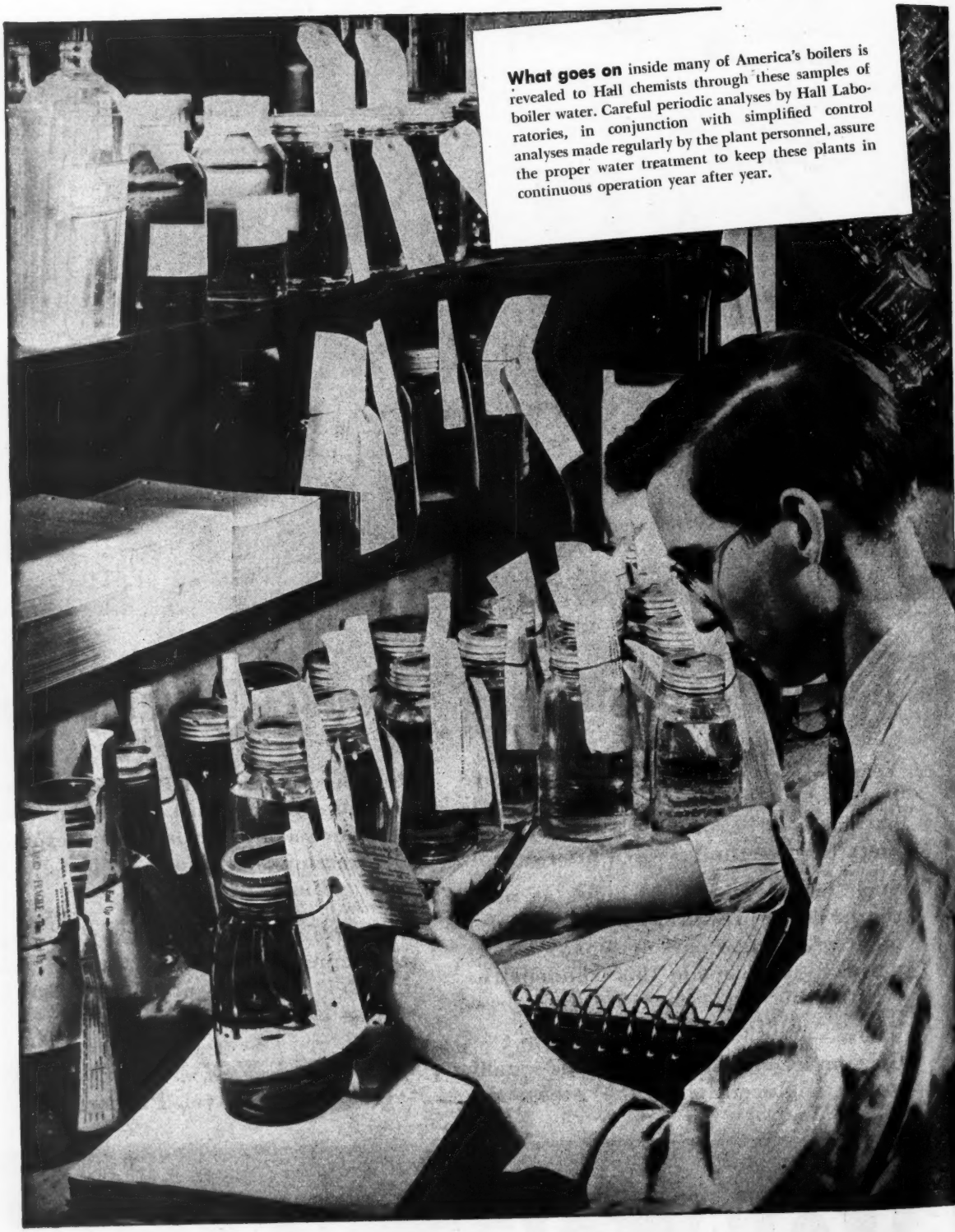
Good boiler engineering demands equally sound engineering in the accessories that become part of it. It is not only protection for your investment, but cheap insurance against trouble and expense. The reason why most people specify Yarway Blow-Off Valves.

What are your draining or blow-down requirements? Write for Catalog. Section B-431 for pressures up to 2500 lb; Section B-424 for lower pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Phila. 18, Pa.

BLOW-OFF VALVES

Why successful



What goes on inside many of America's boilers is revealed to Hall chemists through these samples of boiler water. Careful periodic analyses by Hall Laboratories, in conjunction with simplified control analyses made regularly by the plant personnel, assure the proper water treatment to keep these plants in continuous operation year after year.

boiler operation is an *"inside job!"*

PROGRESS began in water conditioning service when a group of Hall chemists started the research into what goes on *inside* a boiler. At that time power plant operators were at the mercy of scale, corrosion, carryover and embrittlement.

To this simple, and now clearly obvious approach to the problems of boiler water conditioning, which Hall Laboratories follow as vigorously today as they did twenty years ago, the entire steam power world is indebted. One by one the mysteries surrounding the effects of steam under high pressures and high temperatures have been solved. On learning the causes the road was cleared for finding the remedies.

Out of this knowledge and experience has come the best system ever devised for keeping a boiler out of trouble arising from water—THE HALL SYSTEM OF PREVENTIVE CARE. Operated within your own plant, by your own personnel under direct Hall field supervision, it effectively eliminates unscheduled outages which owe their origin to scale, corrosion, embrittlement and carryover.

Today, in many of the country's leading power plants, Hall preventive care is as much a part of their operating system as the very boilers in which it is employed. The reason is plain. It brings results. They have the comforting assurance that behind it is the world's most authoritative source for the solution of water conditioning problems.

You can probably remember the time when the only clean boiler was a new one. Today, through Hall preventive care, countless veteran boilers are contributing mightily to war production. May we give you further facts about this service?

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A Subsidiary of Hagan Corporation

Water samples are accurately checked to see that oil content is being kept to an absolute minimum.

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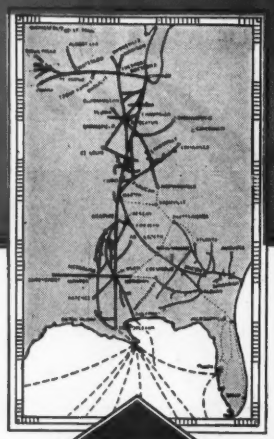
HALL SYSTEM *of Boiler Water Conditioning*

Hall Service in a Nutshell

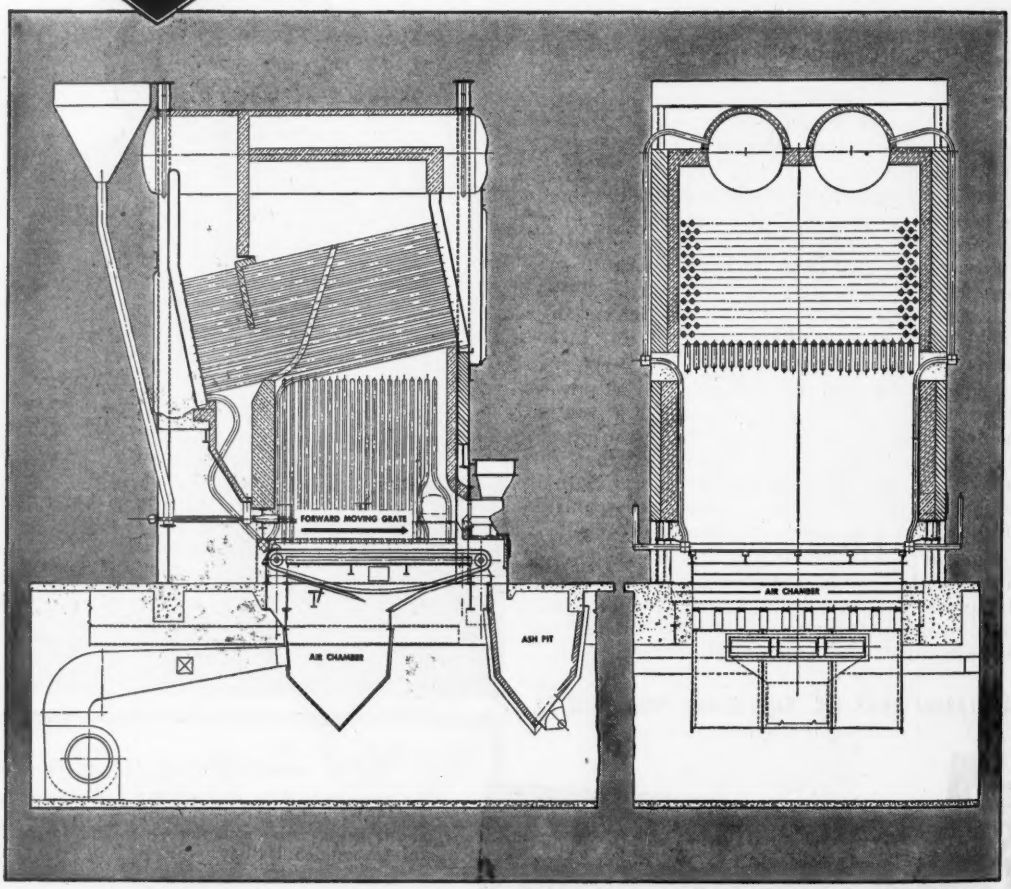
At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. **Minimizes boiler outages caused by water**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**



ILLINOIS CENTRAL

RotoGrate is a CONTINUOUSLY CLEANING spreader stoker with a FORWARD MOVING GRATE that permits higher burning rates with fuels of either high or low ash content.

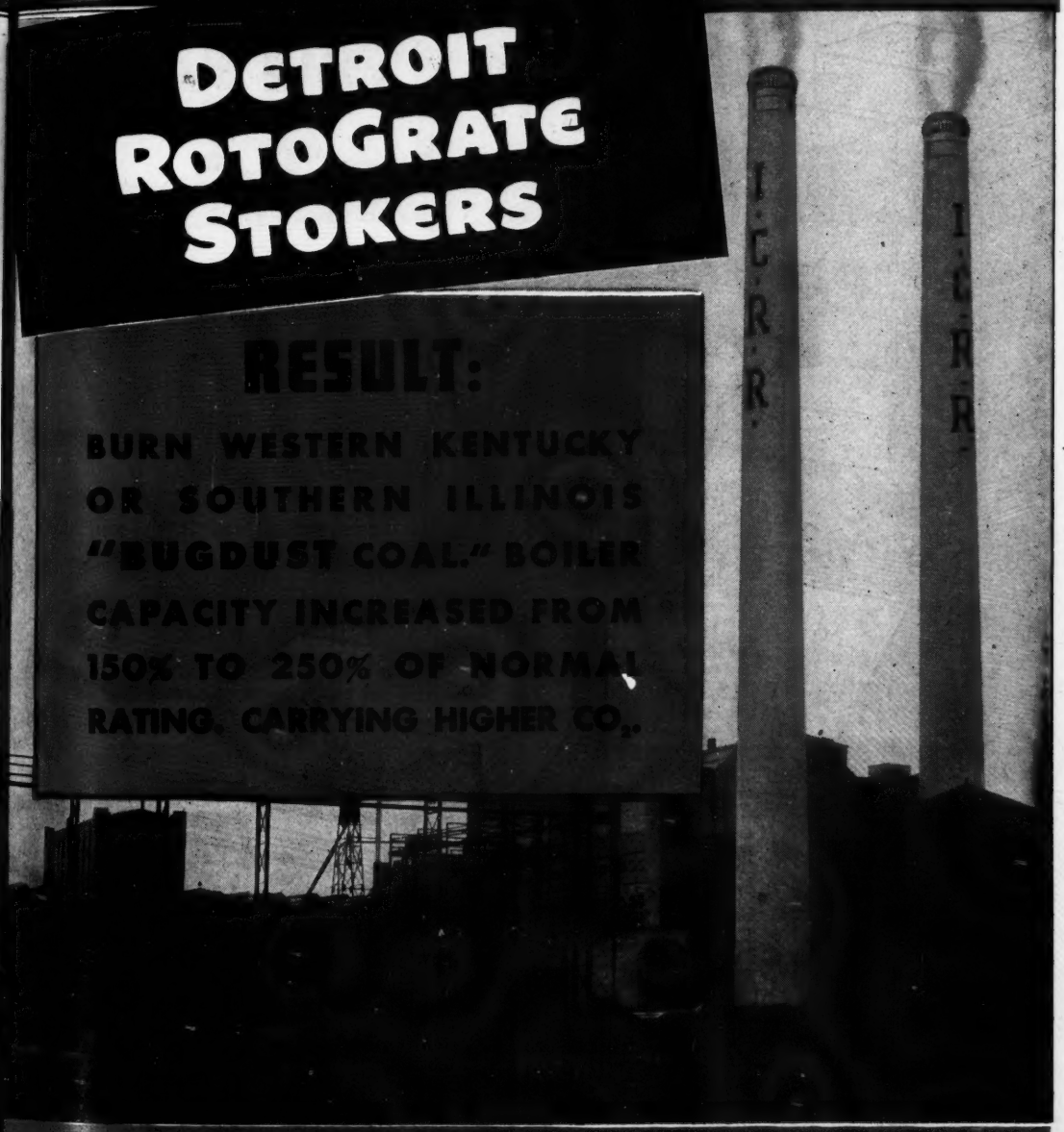


Modernized boilers with water walls and RotoGrate Stokers or Pulverizers

DETROIT STOKER COMPANY

SYSTEM *Uses . . .*

DETROIT ROTOGRATE STOKERS



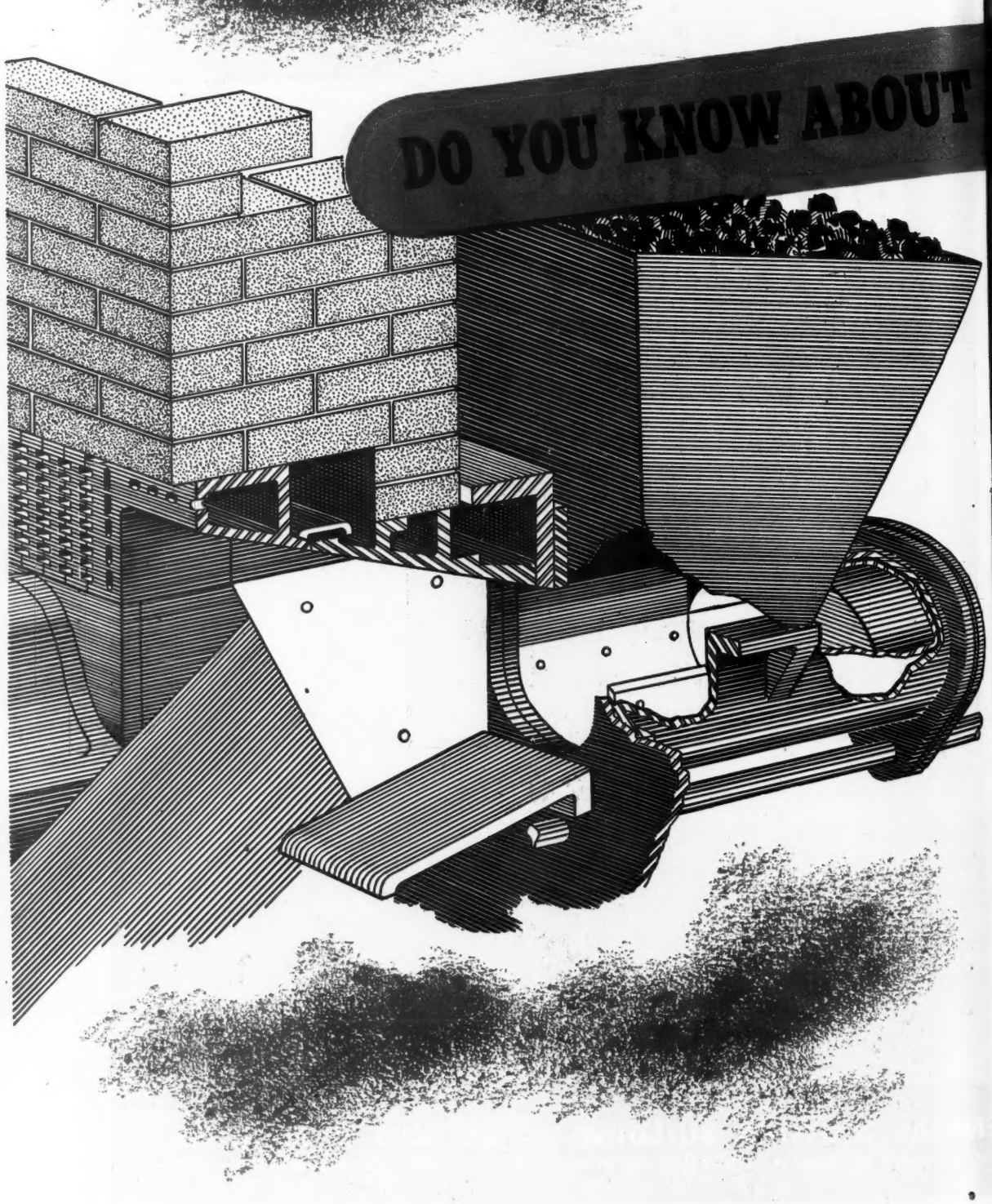
RESULT:

BURN WESTERN KENTUCKY OR SOUTHERN ILLINOIS "BUGDUST COAL." BOILER CAPACITY INCREASED FROM 150% TO 250% OF NORMAL RATING. CARRYING HIGHER CO_2.

Illinois Central Railroad [illegible], Kentucky

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario


DO YOU KNOW ABOUT

THE IMPORTANT BENEFITS OF . . .

RENEWABLE LINERS AND PLATES?

THE ABRASIVE ACTION of tightly compressed coal passing through any stoker feeding mechanism subjects the ram box and throat to severe punishment.

Because of this condition, Taylor Stoker design calls for renewable liners of the ram box and renewable wearing plates of the side plate brackets. These liners and plates are comparatively small, easy-to-install sections that add to the reliability of the feeding mechanism. They also cut to a minimum the time and material cost of replacements.

Taylor renewable liners and plates, like many features of the Taylor Stoker, contribute to greater overall economy of steam generation. Such engineering once again shows the importance of experience that has been specialized on the development of stokers and that utilizes many decades of knowledge of Stoker operation.

A-E-CO TAYLOR STOKERS
LO-HED HOISTS • HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

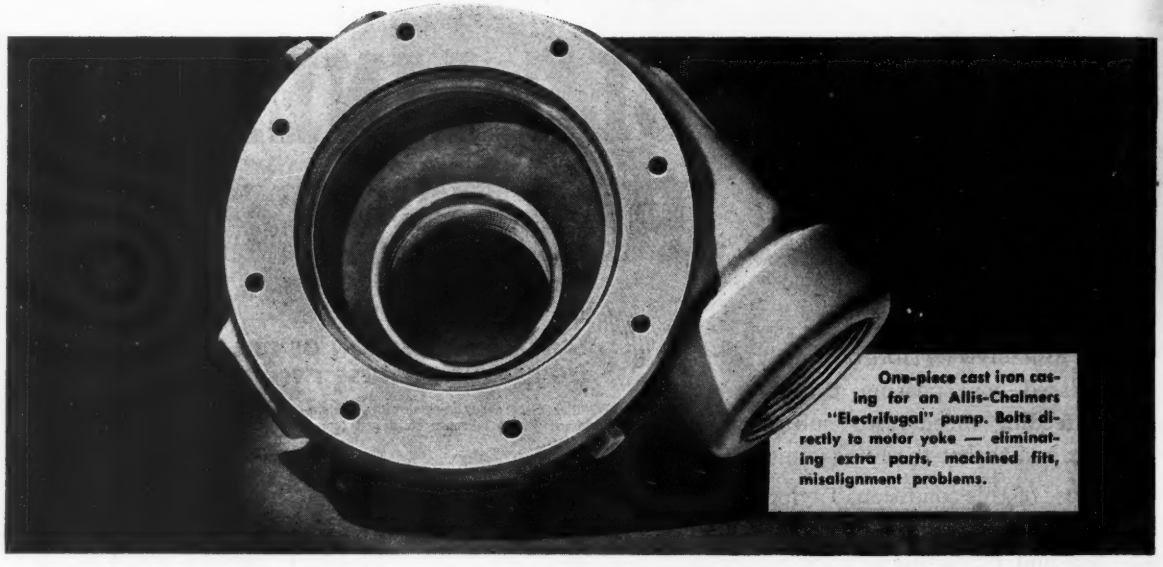
12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make CASINGS Last Longer . . .



One-piece cast iron casing for an Allis-Chalmers "Electrifugal" pump. Bolts directly to motor yoke — eliminating extra parts, machined fits, misalignment problems.

ABRASION AND CHEMICAL REACTION are the major causes of casing wear. For if liquid is gritty, or contains foreign matter; or casing is not constructed of the right materials for the pumping service required — casing life is materially shortened. A minor cause of direct casing wear is misalignment.

Original engineering of a pump can help prevent this wear. For example, Allis-Chalmers "Electrifugal" pump minimizes trouble from these sources in two ways: 1 — casings can be supplied in iron, bronze, stainless steel or other materials — depending upon type of service. 2 — It is a *unit-design* pump. Both impeller and motor are mounted on *one* shaft and in *one* frame. This means fewer parts, fewer fits — no chance for misalignment.

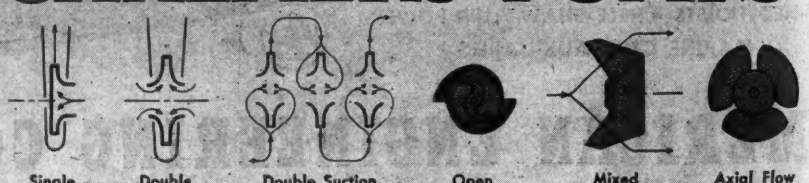
However, regardless of pump design, scheduled maintenance is still necessary if you expect to get longest wear from your casings. Some ways to do it . . .

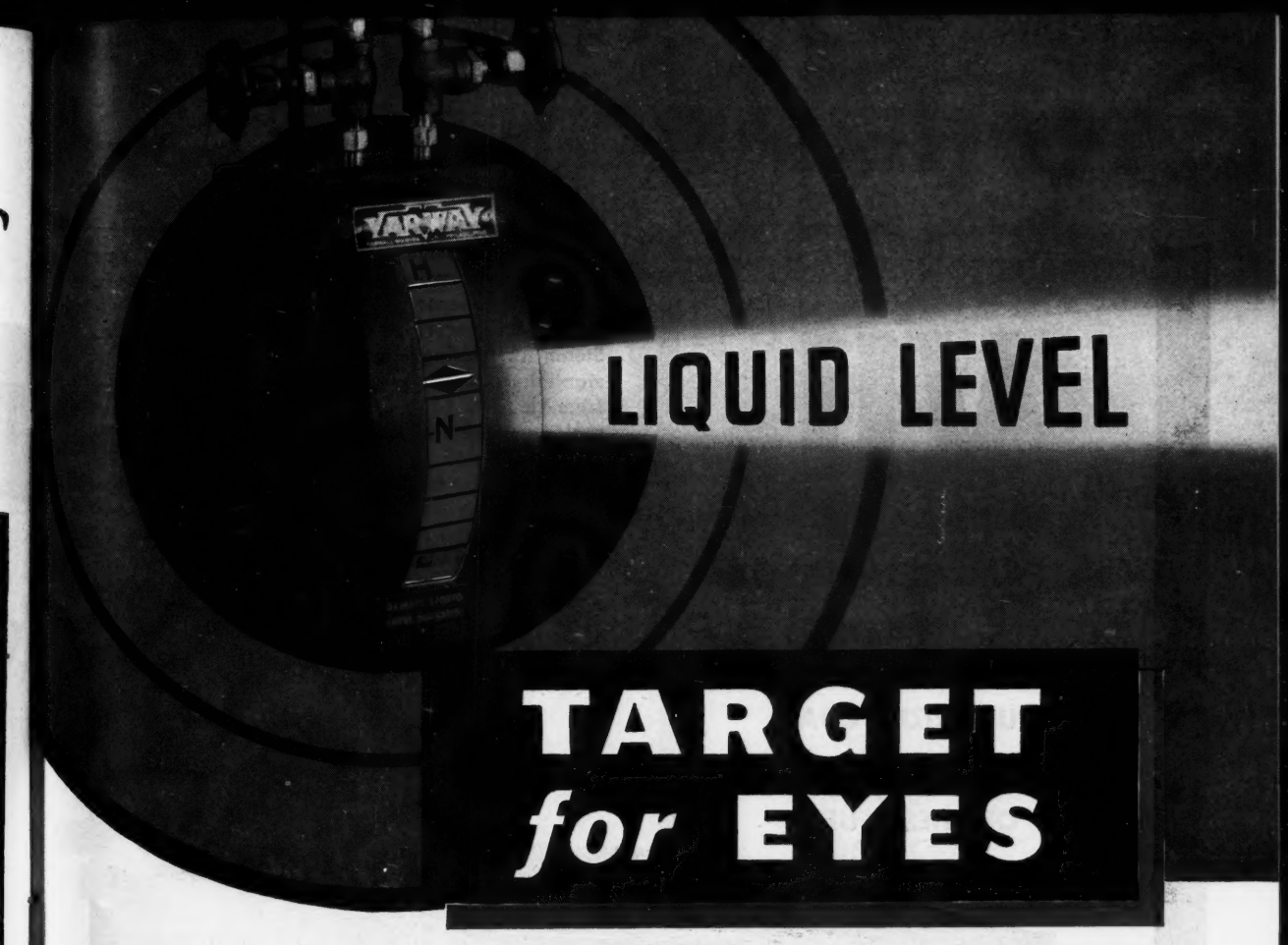
- Check all piping supports regularly to see that they're effectively supporting the load.
- Every 6 months check piping itself to see whether it has shifted in any manner. Disconnect suction and discharge piping to see if it springs in any direction. Check the alignment of pump and motor — shimming up units as required.
- Once a year clean and inspect casing for wear, deposits or pitting. Make necessary repairs.
- If foreign matter is being sucked into pump, wearing casing unduly, provide the intake end of suction piping with a suitable screen.
- Send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". This valuable booklet applies to *all makes* of pumps; contains *no* advertising. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS. A 1755

Tune in the Boston Symphony, Blue Network, every Sat. Eve.

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 ibs.





TARGET *for* EYES

OUTSTANDING FEATURES

Eye Level Readings of boiler water or other liquid levels on instrument panel or other convenient location.

•

Instant, Accurate Indication —a positive check on remote, hard-to-see liquid level gages.

•

Operated by the boiler water —itself. "Positive as the law of gravity."

•

No stuffing boxes. Frictionless Mechanism — Jewelled Bearings.

•

Indicating mechanism never under pressure. Magnetic transmission between actuating and indicating mechanism.

•

Indicates in full or reduced scale. Up to 8 ft. level variation.

•

Compact—Moderately Priced. Available for all pressures up to 1500 lb.

•

Easily Installed on new or existing equipment.

Now, stop squinting and guessing at boiler water levels. End the risk of serious damage to important equipment. Keep accurate check on other liquid levels in your plant.

With the Yarway Remote Liquid Level Indicator—"the Eyes have it" all the time, right in front of them—on instrument panel or wall, wherever it's most convenient and prominent. Quick, accurate, eye-level readings regardless of location of the levels to be checked.

Hundreds in Use

Read the features listed at the left. Facts that have already influenced the purchase of hundreds of Yarway Instruments for utilities, industrial plants, institutions and marine service.

And everywhere, use has multiplied satisfaction with this positive, accurate, dependable, *popularly-priced instrument.*

A Development of the Yarway Steam Laboratory

The Yarway Remote Liquid Level Indicator is another development of the unique Yarway Steam Laboratory, responsible for all new Yarway products and improvements. Here, a device must be right or it never meets the public. For instance, for the past three years, an accelerated endurance test has been carried out on a standard stock Yarway Indicator. In continuous operation, day and night, under rapidly-changing liquid levels that produced full pointer travel, the mechanism has operated through 17 million complete travel cycles —equivalent to 50 years of ordinary boiler room service, with no repairs, replacements of parts or change in calibration.

Why not get this positive, dependable, convenient indication of the liquid levels in your plant?

For further information, write for Bulletin WG-1820.

YARNALL-WARING COMPANY · 114 Mermaid Ave., Phila. 18, Pa.

YARWAY REMOTE LIQUID LEVEL INDICATOR

TO HELP YOU MEET

COMBUSTION ENGINEERING

VU

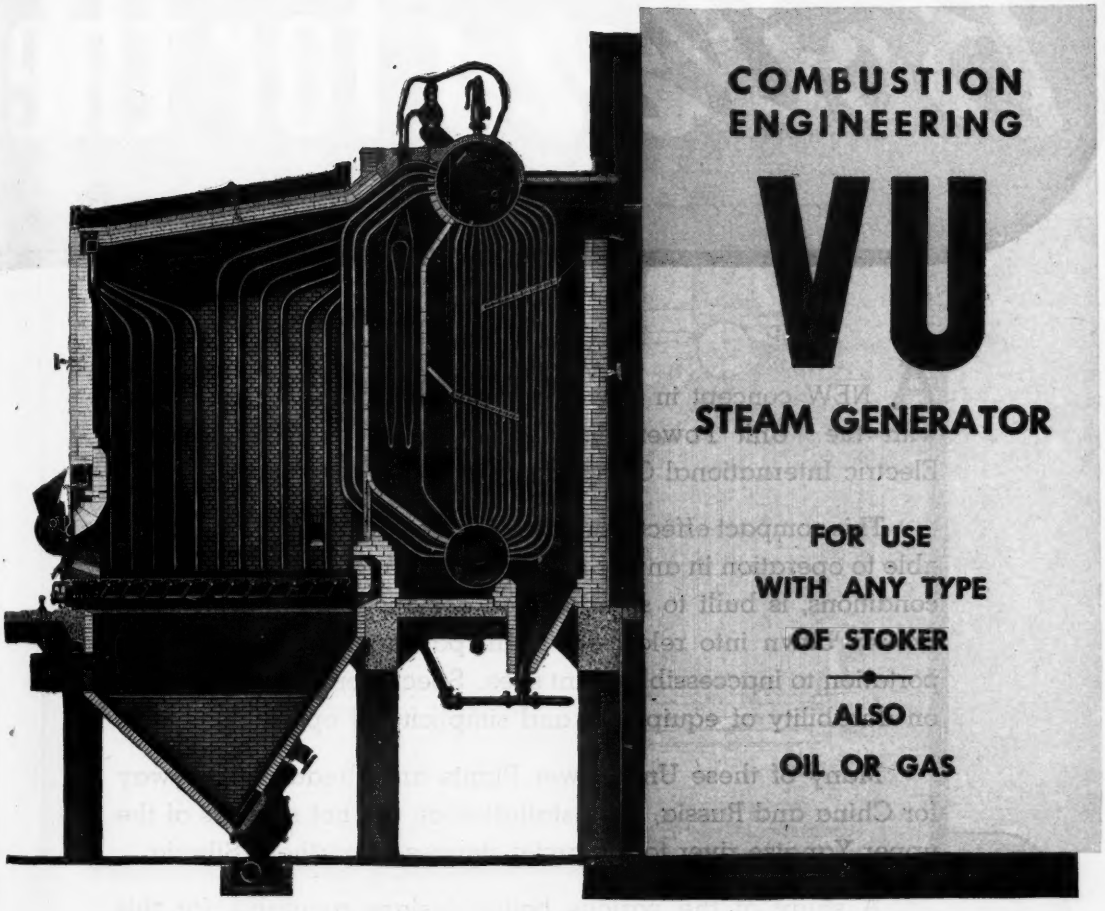
STEAM GENERATOR

FOR USE WITH PULVERIZED COAL, OIL, GAS OR COMBINATIONS OF THESE FUELS

There may still be many unanswered questions as to post-war business conditions, but there's one thing of which we can be certain — competition is going to be keener than ever, and low-cost production will therefore be of the utmost importance. Steam for heating, power and process enters substantially into the cost of virtually all products — from gadgets to heavy equipment, yet the vast majority of American manufacturers are still handicapped by high steam costs. Here, then, is a big opportunity for alert engineers to make a real contribution to the lower production costs their managements will need to meet post-war competition. To such engineers we suggest investigation of the reduced steam costs obtainable with Combustion Engineering's Type VU Steam Generator.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATE

POST-WAR COMPETITION



Reasons for the Economy of this C-E Unit

There are two principal reasons for the economy of the VU Steam Generator:

HIGH EFFICIENCY: VU Units in the smaller capacity range, stoker fired and without heat recovery equipment, operate at efficiencies in the neighborhood of 80 per cent, depending on type of stoker and fuel. The larger VU Units with heat recovery equipment operate at efficiencies up to 88 per cent. These are not test efficiencies, nor optimistic claims; they are figures taken from average monthly records of users.

LOW MAINTENANCE AND OUTAGE: Ability to stay on the line for long periods means low maintenance and avoidance of serious outage losses. Many users of VU Units have reported exceptional service records. Here are a few recent ones: "works around the clock, 7 days a week for months on end until we shut down for scheduled inspection" . . . "in continuous operation for 9 months since first placed in service" . . . "two units, on the line 97% of all the time for a year."

Further evidence of the efficient, economical performance of VU Units is their wide acceptance throughout the world. Not only are there hundreds of installations in the United States and Canada, but also in Arabia, China, Russia and other remote regions where equipment *must* be good because service engineers are not available.

VU Units will give you the overall economy you will need to meet post-war competition coupled with high fuel costs. Then you will find that the best equipment you can get is the least expensive. A-825

Combustion Engineering

200 MADISON AVENUE NEW YORK 16, N. Y.

Boilers for the

A NEW concept in power generation made its appearance with the "Unit Power Plant", developed by Westinghouse Electric International Company.

This compact effective steam-electric generating unit, adaptable to operation in any part of the world and under all climatic conditions, is built to standardized designs, permitting it to be broken down into relatively small packages for ready transportation to inaccessible plant sites. Special emphasis is placed on durability of equipment and simplicity of operation.

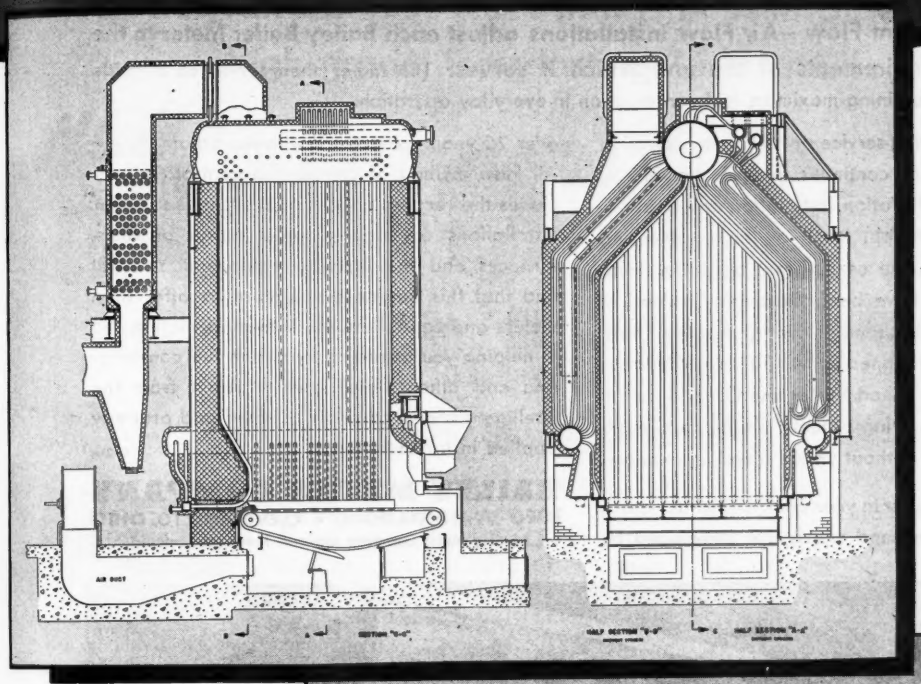
Many of these Unit Power Plants are already under way for China and Russia, for installation on the hot reaches of the upper Yangtze river to the arctic steppes of northern Siberia.

A study of the various boiler designs available for this severe duty led to the selection of Foster Wheeler type S-A steam generators for thirty-seven plants, the record showing that "all parties agreed upon this boiler as best adapted to meet the peculiar design, erection and operating conditions involved. Its compactness, freedom from unmasked refractories, adaptability to a variety of fuels, methods of firing and its free circulation influenced the selection."

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, N. Y.

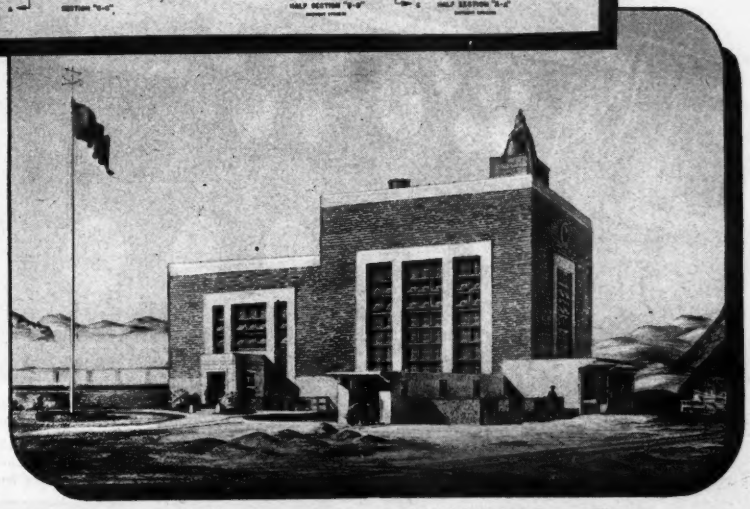
FW FOSTER

UNIT POWER PLANTS



Sectional view of S-A type boiler destined for China.

Foster Wheeler is a four star winner under the U. S. Navy Board of Awards for production.



Architect's drawing of completed Russian Power Plant.

WHEELER

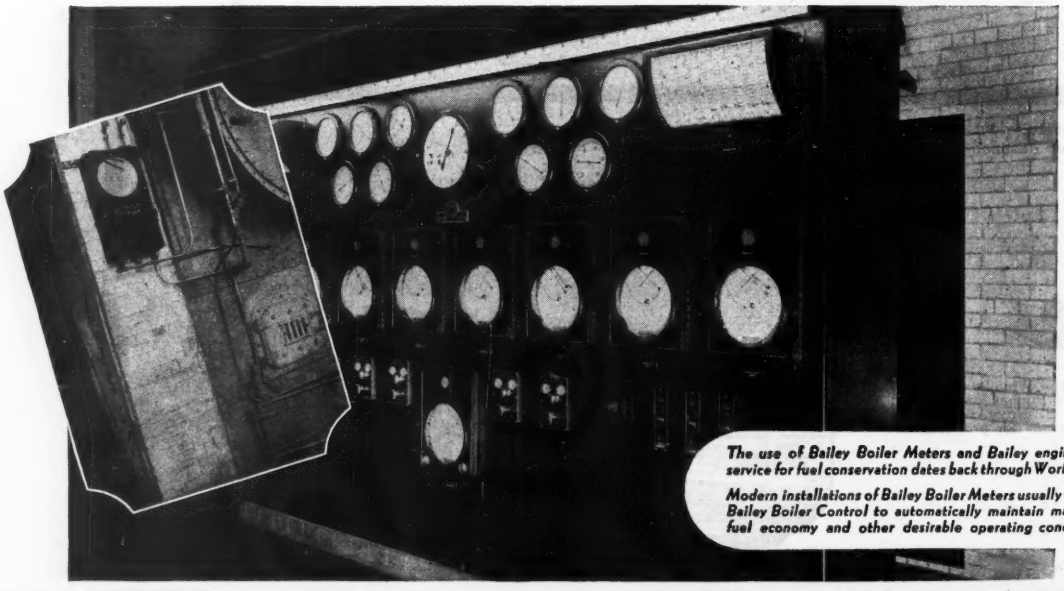
BAILEY BOILER METERS— YOUR PASSPORT to ENGINEERED FUEL CONSERVATION

Bailey Field Engineers backed by the know-how gained from thousands of successful Steam Flow—Air Flow installations adjust each Bailey Boiler Meter to the particular requirements of the unit which it serves. The meter then serves as a guide to firemen in obtaining maximum fuel conservation in everyday operation.

Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Much of this engineering work is done in the user's plant by Bailey Field Engineers who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has "know-how" at his command which was developed by over 25 years experience with the Steam Flow—Air Flow method of combustion control. This includes the records of tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that this engineer has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation and other benefits which result from the intelligent use of correctly selected and properly applied instrumentation. G-21A

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada



The use of Bailey Boiler Meters and Bailey engineering service for fuel conservation dates back through World War I.

Modern installations of Bailey Boiler Meters usually include Bailey Boiler Control to automatically maintain maximum fuel economy and other desirable operating conditions.

BAILEY METER CONTROL

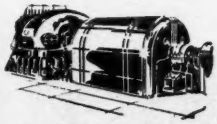
The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

EXTRA RESISTANCE TO OXIDATION, RUST

...added to a base stock that is in itself an excellent, high-grade, long-lasting Turbine Oil...

NEW GARGOYLE D.T.E. OIL!



THIS great new turbine oil —Gargoyle D. T. E. Oil 797—combines all three of the factors needed to make the ideal turbine oil—a base stock that is in itself an excellent turbine oil, maximum resistance to oxidation and maximum anti-rust qualities.

As a result, Gargoyle D. T. E. Oil 797 has already proved its superiority. In severe oxidation tests, it stood up a great deal longer than other leading turbine oils.

Now, Gargoyle D.T.E. Oil 797 is meeting today's greatly increased operating temperatures in turbines ranging from 1500 KW to 50,000 KW.

Your local Socony-Vacuum representative can give you full details about this new oil. Be sure to get the facts from him . . . and get Gargoyle D.T.E. Oil 797 in your turbine.

SOCONY-VACUUM OIL CO., INC.•Standard Oil of N.Y. Div.•White Star Div.•Lubrite Div.•Chicago Div.•White Eagle Div.•Wadhams Div. • Magnolia Petroleum Co. • General Petroleum Corp. of Calif.

GARGOYLE

Lubricants

WHAT MAKES A GREAT TURBINE OIL?

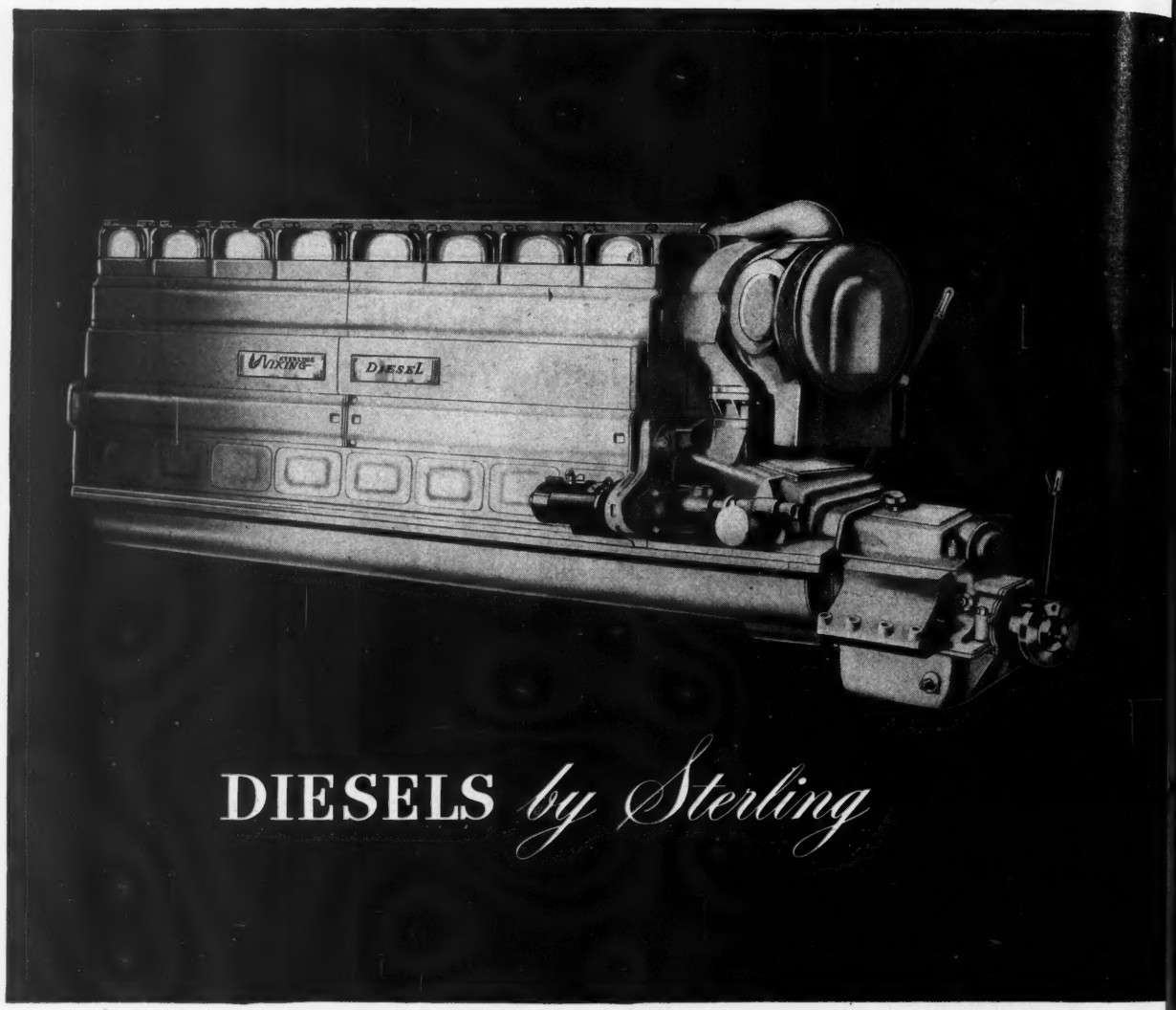
✓ ***Excellent Base Stock:*** The fundamental requirement for an ideal turbine oil is a base stock that in itself is an excellent turbine oil with excellent resistance to oxidation.

✓ ***Extra Resistance to Oxidation:*** Oxidation protection —PLUS—is needed to meet the effect of greatly increased temperatures in modern turbine operation. Your turbine oil should have this PLUS protection.

✓ ***Maximum Anti-Rust Qualities:*** The possibility of the presence of water demands that the oil should furnish maximum protection against corrosion. Your turbine oil should give this protection.

THE NEW GARGOYLE D. T. E. OIL 797 HAS ALL OF THESE NECESSARY CHARACTERISTICS

FROM THE LEADER IN LUBRICATION: Socony-Vacuum Oil Co., Inc.



DIESELS *by Sterling*

★ *The achievement of 40 years building quality engines for marine and industrial use*

● For many years before Pearl Harbor Sterling engineers were experimenting on a new type diesel engine—a medium duty power plant combining the compactness of a gasoline engine with the efficiency of diesel operation and the economy of diesel fuel.

Now ready for delivery is their achievement—the new Sterling Viking diesel. Here is a compact medium duty power plant rugged enough to give heavy duty performance—yet it operates on two-thirds or less the amount of fuel consumed by a gasoline model of similar rating.

If you are replacing your present power plant or laying plans now for present or future needs, Sterling engineers will be glad to cooperate in furnishing full information for installing the new Viking diesel. Write us for details.

STERLING ENGINE COMPANY
1272 Niagara Street, Buffalo 13, N. Y.
OFFICES IN NEW YORK, WASHINGTON AND CHICAGO

Sterling engines... diesel, gasoline or gas—in marine and stationary models... are now available in horsepowers from 85 to 1200.

SPECIFICATIONS . . . STERLING VIKING DIESEL

Supercharged and Unsupercharged—6 and 8 cylinder

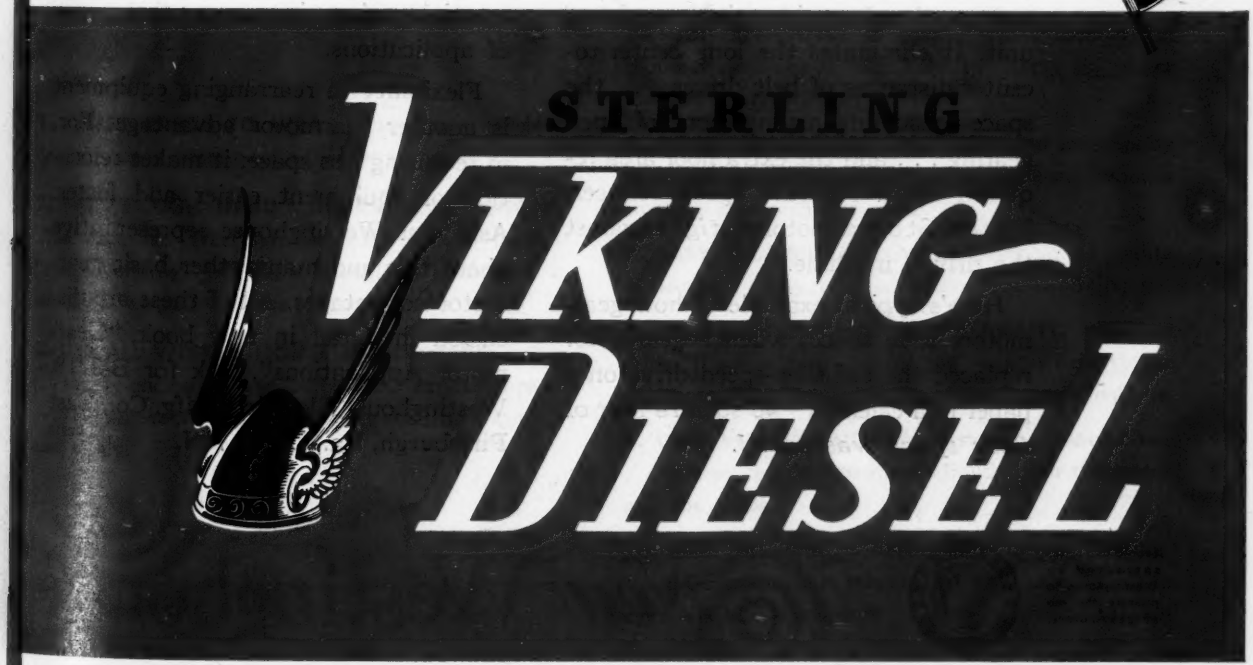
HORSEPOWER RATINGS AND WEIGHT

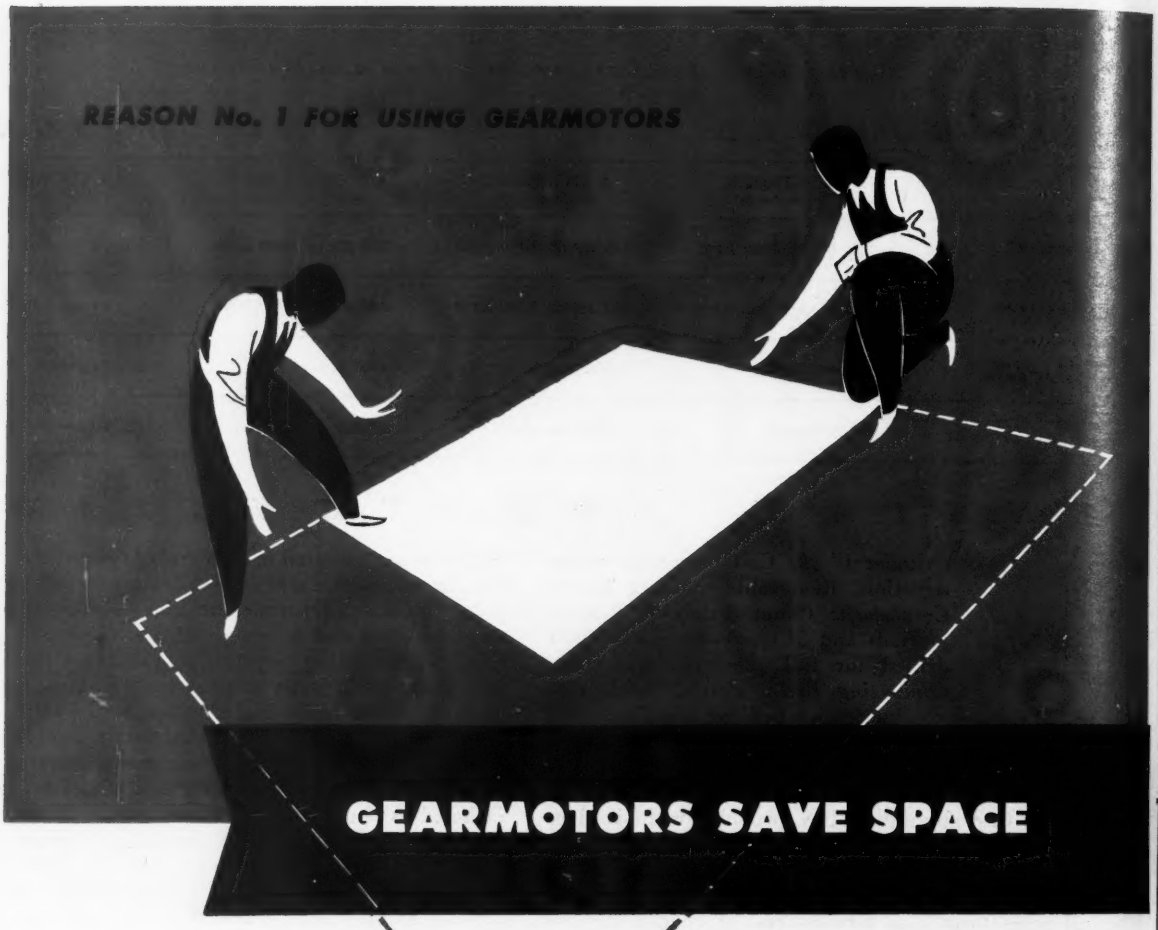
	6 CYLINDER *Unsupercharged*	6 CYLINDER *Supercharged*	8 CYLINDER *Unsupercharged*	8 CYLINDER *Supercharged*
CONTINUOUS	275 HP @ 1000 RPM	410 HP @ 1000 RPM	365 HP @ 1000 RPM	550 HP @ 1000 RPM
INTERMITTENT	325 HP @ 1200 RPM	495 HP @ 1200 RPM	440 HP @ 1200 RPM	650 HP @ 1200 RPM
WEIGHT WITH REVERSE GEAR	8,000 pounds	8,500 pounds	10,000 pounds	10,500 pounds
WEIGHT WITH REVERSE AND REDUCTION GEAR	10,000 pounds	10,500 pounds	12,000 pounds	12,500 pounds

ENGINE CONSTRUCTION

Cylinder Block: Cast iron enbloc construction. Removable cylinder liners. *Crankshaft:* Counterbalanced 6″ main journals and 5″ crankpins. Crankshaft drilled for full pressure lubrication. *Connecting Rods:* Forged steel, rifle drilled for pressure lubrication to piston pin. *Camshaft:* Located in cylinder block. Removable from side of engine. *Bearings:* Main bearings, connecting rod bearings and camshaft bearings are precision type steel backed. *Pistons:* Cast aluminum alloy, provided with six rings and full floating piston pin. *Valve Mechanism:* Dual intake and exhaust valves actuated by hydraulic lifters through push rods and rocker arms. *Timing Gears:* Helical gears located at forward end of engine. *Reverse Gear:* Bevel planetary type, manual or remote control. Thrust bearing located in after end of reverse gear housing. *Lubrication:* Pressure lubrication to all moving parts. Dry sump. Separate gear driven positive displacement pressure and scavenge pumps. *Cooling System:* Fresh water cooling. Separate gear driven self-priming centrifugal fresh water and sea water pumps. *Fuel Injection System:* Individual cam operated pumps. Nozzles located in center of cylinder heads. Fuel transfer pump gear driven positive displacement. *Supercharger:* Exhaust driven, located at after end of engine. Water-jacketed exhaust manifold. *Governor:* Hydraulic variable speed. Provision is made for remote control. *Starting System:* Two electric starting motors. Gear driven generator for battery charging. *Tachometer and Revolution Counter:* Gear driven electric tachometer and mechanical revolution counter.

"KEEP BUYING WAR BONDS"





GEARMOTORS SAVE SPACE

The gearmotor combines prime mover and speed reducer in a single compact unit. It eliminates the long center-to-center distances of belt drives . . . the space-consuming arrangement of open gearing . . . and the extra floor area required by a separate speed reducer. You can fit a gearmotor up *tight* against the driven machine.

Here's typical example of how gearmotors save space: when a gearmotor replaced the old slow-speed drive on a paper mill calender—*40 square feet of floor space was saved.*

Gearmotors are making equally substantial savings in many other types of applications.

Flexibility in rearranging equipment is another gearmotor advantage. For, in requiring less space, it makes relocation of equipment easier and faster. Ask your Westinghouse representative about this and many other basic gearmotor advantages. All of these are discussed in detail in new book, "Gearmotor Applications". Ask for B-3218. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-07218

Second of a series sponsored by Westinghouse to promote the use of gearmotors.

The New Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

10 GOOD REASONS FOR USING WESTINGHOUSE GEARMOTORS

1. FEWER PARTS TO WEAR. The simple, efficient design uses a minimum of moving parts.

2. BPT "TOUGH-HARD" GEARS AND PINIONS. This exclusive Westinghouse heat-treating method "tough-hardens" teeth for maximum resistance to shock and impact—means longer wear.

3. USE ALL WESTINGHOUSE MOTOR TYPES—open . . . totally-enclosed . . . splashproof . . . explosion-proof —to help meet changes in operating conditions quickly and easily.

4. INTERCHANGEABILITY OF PARTS between unit types reduces your parts' replacement stock by 40%.

5. HIGH EFFICIENCY of gearing parts assures full motor horsepower at output shaft . . . only 2% power loss per gear set.

6. POSITIVE LUBRICATION of gears and bearings by automatic splash system reduces probable maintenance to twice-a-year change of oil.

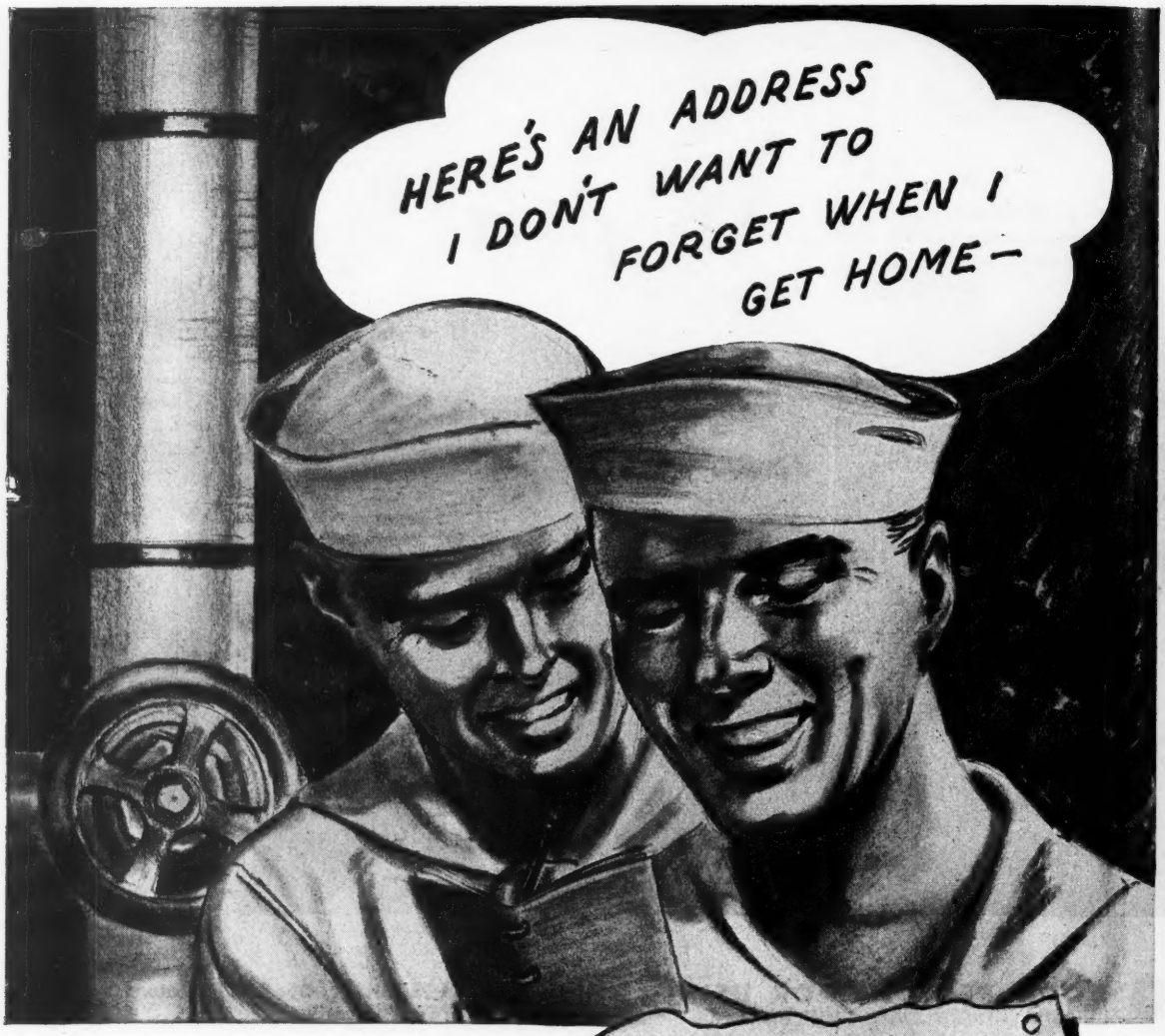
7. EASY ACCESSIBILITY. Gearing parts can be readily inspected or easily removed to effect gear ratio changes.

8. IMPROVED FOUNDATION STABILITY. Feet are under the gear case . . . placing support next to the gearmotor load. Each foot is reinforced by external ribs.

9. UNIT RESPONSIBILITY for design . . . manufacture . . . and service. Westinghouse builds both the motor and the gears.

10. MEET A.G.M.A. STANDARDS. The new Westinghouse Gearmotors are specifically designed and built to meet A.G.M.A. standards . . . easy to order and match to the job.

Gearmotors



GARLOCK LATTICE-BRAID PACKING. The unique structural design imparts semi-automatic pressure action. Available in several styles for various types of service.

"GARLOCK Packings and Gaskets are doing a job on our ships—they'll help us lick our packing problems at the plant back home, too!"

"And don't forget how well those KLOZURE Oil Seals are working out."

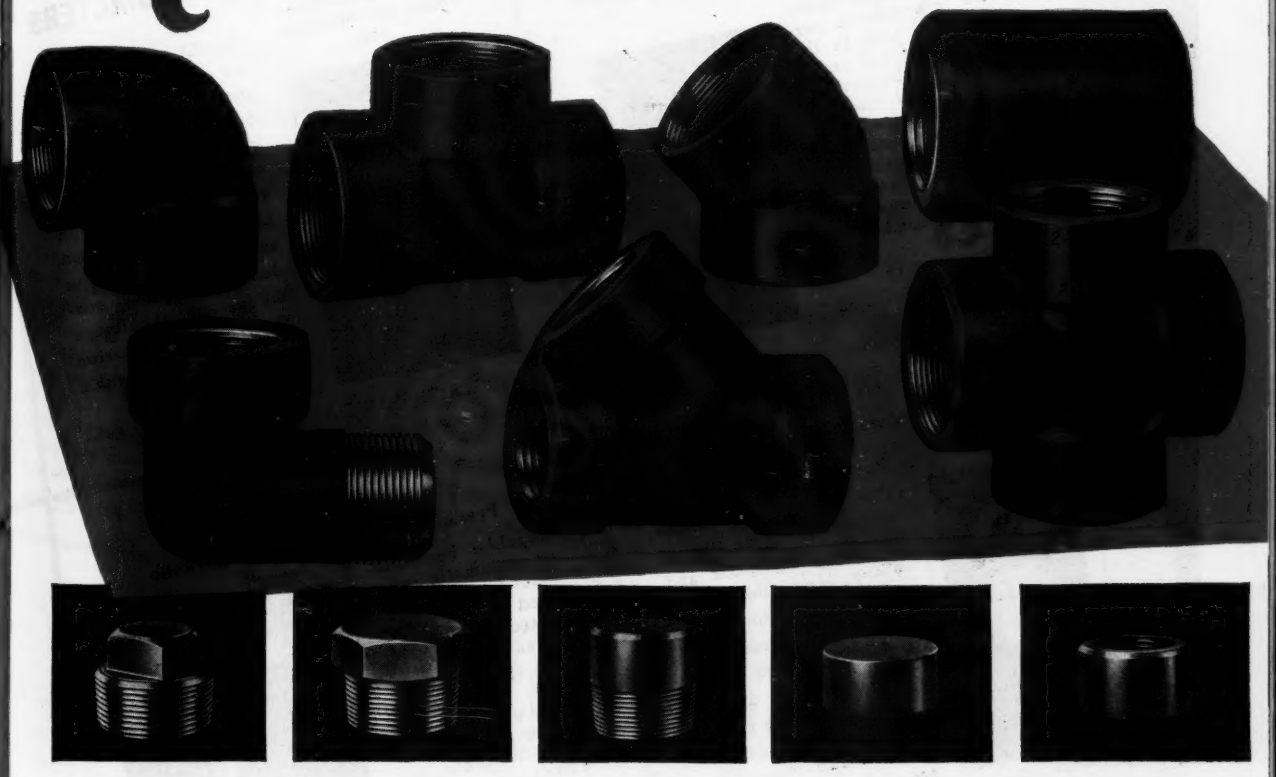
Yes, GARLOCK products give superior performance for our Armed Forces and for industry everywhere. You can rely on their dependable service.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

LADISH Controlled Quality

Forged Steel Pipe Fittings



• The complete line of Ladish Forged Steel Pipe Fittings manufactured under the same *Controlled Quality* procedures that characterize all Ladish products is available to you in Carbon and Alloy Steel. Pressures from 2000 to 6000 lbs.

Forged Steel Screwed Fittings

Full depth thread, accurately cut, results in pressure-tight joints. Pipe enters easily. Uniform thickness. Sizes clearly marked . . . ¼" through 4".

Socket Welding Fittings

Speed up installation because deep sockets save time formerly required to cut pipe to exact length. Socket supports pipe and allows self-alignment. No machining of pipe necessary for fit. ASSURED WELDABILITY. Sizes clearly marked . . . ¼" through 4".

ARMY NAVY E

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

MILWAUKEE SUBURB

New York Office: 60 E. 42nd Street, New York City

Houston, Texas Office: 1005 Sterling Building

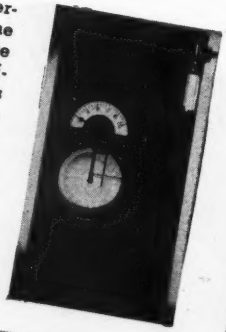
TO MARK PROGRESS

B. t. u. Savers

CO_2 METERS

An Automatic Orsat—For Checking Combustion Efficiency

For every fuel and boiler, there is a definite percentage of CO_2 in the flue gas that will assure highest combustion efficiency. Less than this amount indicates an excess of combustion air, causing high stack loss. The CO_2 meter is the only method of accurately determining combustion efficiency.



WRITE FOR DATA BOOK No. 403

RECORDING THERMOMETERS

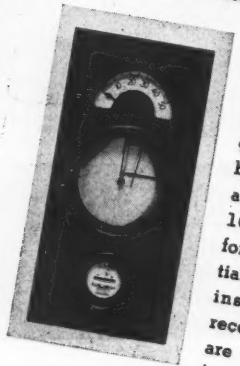
Remote Reading—Single and Multiple Pen

Republic thermometers are available for recording temperature of flue gas, temperatures in vats or tanks either open or closed and under pressure, temperatures in pipe lines, refrigeration systems, ovens, kilns or ducts. For unusual conditions, special bulbs are furnished of corrosion resisting metal or with a protective coating.

WRITE FOR DATA BOOK No. 210

FLOW METERS

Electrical Remote Reading Type



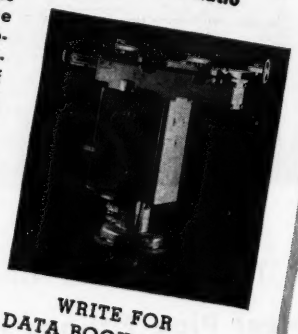
Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator — are of the remote reading type.

WRITE FOR DATA BOOK No. 701

REGULATORS

Pressure—Flow—Speed—Level—Ratio

Republic hydraulic or pneumatic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

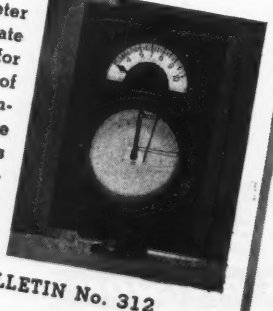


WRITE FOR DATA BOOK No. S-13

FLOW METERS

Mechanical Float Type

The Republic mechanical float type meter is a simple, accurate metering device for measuring the flow of steam, water, gas, compressed air, oil, brine and other fluids. It has been designed primarily for installations where remote registration is not required.



WRITE FOR BULLETIN No. 312

DRAFT AND PRESSURE INSTRUMENTS

Diaphragm Actuated Any Number and Combination

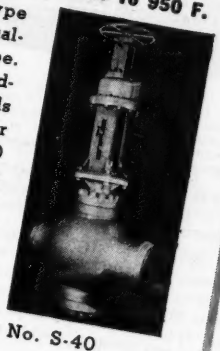
Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic dry-bellows type indicators and recorders are supplied for all ranges encountered in furnace operation in any desired combination.

WRITE FOR BULLETIN No. 802

that will help you stretch your fuel supply

PRESSURE REDUCING AND REGULATING VALVES

Pressure To 2500 lb.—Temperatures To 950 F.

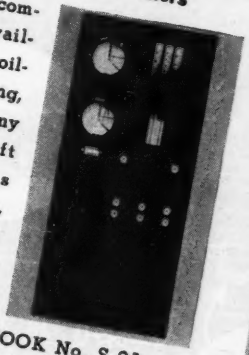


Republic turbine type valves are of the gradual-opening, high-lift type. They are built in accordance with A.S.A. standards and can be supplied for all pressures up to 2500 lb. per sq. in. and for temperatures up to 950 F and for any specified capacity. Republic valves will regulate down to 2% of maximum flow.

WRITE FOR BULLETIN No. S-40

COMBUSTION CONTROL

For All Sizes and Types of Boilers



Republic automatic combustion control is available for all sizes of boilers, all types of fuel firing, all load conditions and any arrangement of draft equipment. It maintains constant steam pressure, highest combustion efficiency, desired load division, constant furnace draft.

WRITE FOR DATA BOOK No. S-21

DESUPERHEATERS

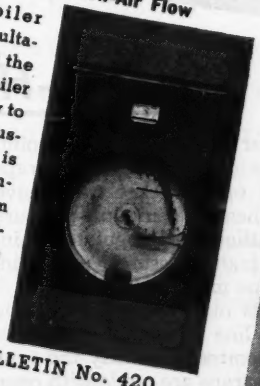
Built To Meet Your Specific Requirements

Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters. These are of the venturi type, with ratio or ratio-tank control, the steam atomizing type and the mechanical atomizing type.

WRITE FOR DATA BOOK No. S-35

BOILER METERS

Record Steam Flow-Air Flow



The Republic Boiler Meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion. The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

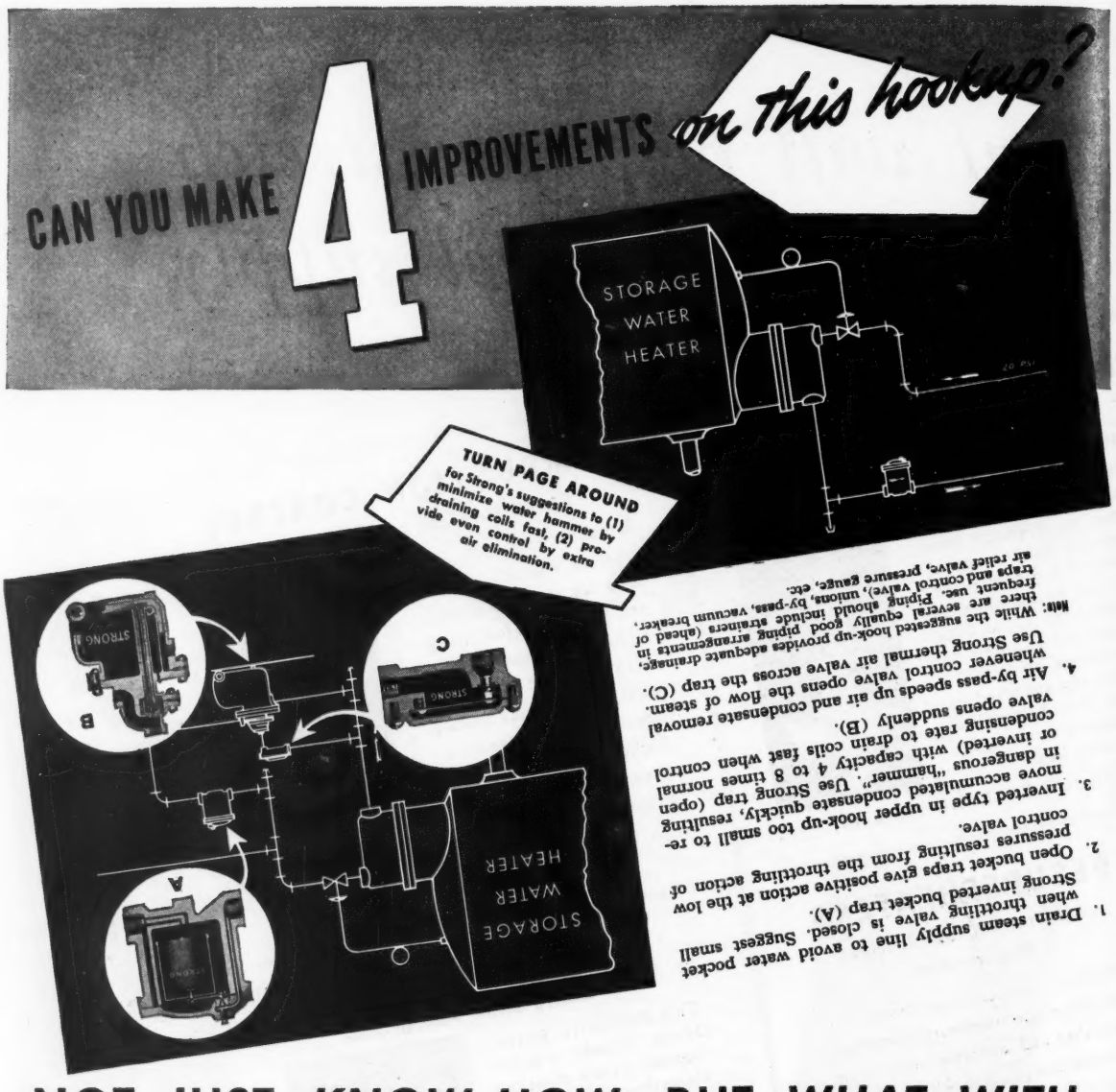
WRITE FOR BULLETIN No. 420

REPUBLIC
INSTRUMENTS
AND CONTROLS

Republic Flow Meters Co.

2222 Diversey Parkway · Chicago 47, Illinois

CAN YOU MAKE 4 IMPROVEMENTS on this hookup?



1. Drain steam supply line to avoid water pocket when throttling valve is closed. Suggest small Strong inverted bucket trap (A).
2. Open bucket traps give positive action at the low pressures resulting from the throttling action of control valve.
3. Inverted type in upper hook-up too small to remove accumulated condensate quickly, resulting in dangerous "hammer". Use Strong trap (open or inverted) with capacity 4 to 8 times normal condensing rate to drain coils fast when control valve opens suddenly (B).
4. Air by-pass speeds up air and condensate removal whenever control valve opens the flow of steam. Use Strong thermal air valve across the trap (C).

Note: While the suggested hook-up provides adequate drainage, there are several equally good piping arrangements in frequent use. Piping should include strainers (ahead of traps and control valve), unions, by-pass, vacuum breaker, air relief valve, pressure gauge, etc.

NOT JUST *KNOW-HOW,* BUT *WHAT WITH*

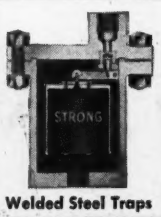
Draining this storage water heater is a case in point. Either Strong inverted or open bucket type traps are commonly used, but open bucket traps have proved most suitable for heaters using low-pressure steam, especially if throttling type regulator is installed. On medium or high pressures, either inverted or open bucket type may be used.

Knowing drainage facts like these and working with the most complete line of steam specialties, Strong engineers can recommend exactly the type and size you need. Strong traps are made with open or inverted buckets, closed float, float-and-thermostatic (blast), forged, fabricated (welded), cast and semi-steel. Anum-Metal valves and seats are guaranteed leak-proof for a year.

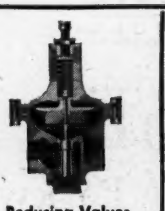
SEND IN YOUR DRAINAGE PROBLEMS. We'll be glad to suggest a remedy for your drainage difficulties. A rough sketch of the piping will do, plus data on differential pressures and difficulties encountered.

STRONG, CARLISLE & HAMMOND COMPANY
Cleveland 13, Ohio

STRONG
STEAM SPECIALTIES



Welded Steel Traps


Reducing Valves

Float Traps

$12,000 failure in a $12 breaker

Could it just as well have been one of yours?

A motor-circuit fault occurred in a busy war-production plant, and the undersized circuit breaker went up in a burst of blue flame. Then, in an instant, the inadequate main circuit breakers failed as well—with a further dangerous blow-up that sent hot metal flying. Not until the power company's breaker tripped out was the short-circuit current brought to a halt. Production of the entire plant was crippled until repairs could be made. The loss exceeded $12,000.

A failure like this—with its threat to production and danger to personnel—strikes more frequently than you think. It could occur tomorrow morning in hundreds of plants where electric circuits are being called upon to handle increased loads that they were never designed to carry. In such "shoestring" power distribution systems, fuses and breakers often lack the capacity to interrupt the full rush of short-circuit current that can flow from the present source.

***One* new circuit breaker is no remedy. The interrupting capacity of *every* protective device, from entrance cable to machine, must be brought into line.**

GENERAL ELECTRIC

***TO BE SURE* of adequate interrupting capacity all through the plant, start making plans now to convert to a G-E load-center distribution system.**

HOW A LOAD-

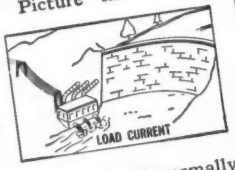
keeps short-circuit

NEED FOR ADEQUATE IC* OFTEN OVERLOOKED

CAPACITY OF SUPPLY SOURCE "TAKES OVER" WHEN SHORT CIRCUIT OCCURS

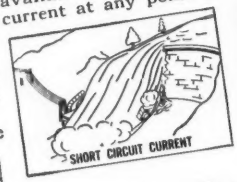
When a short circuit occurs, the flow of current is not limited by the size of the load—it may increase to several hundred times the load current. Thus the load *carrying* capacity of breakers or fuses is no measure of their adequacy as protective devices.

Picture the collapse of a dam which normally supplies a penstock. The resultant damage is limited, not by the capacity of the penstock, but by the head and capacity of the reservoir. So it is with circuit-breaking equipment. Like the rush of water down the valley, too, the damage may be cumulative, so that normally adequate structures below are breached and broken one by one. Failure of an inadequate circuit-interrupting device may cause a new, more serious short within the device itself as parts are welded under the intense heat.



CALCULATING SHORT-CIRCUIT CURRENT

Accurate methods now exist for calculating the available short-circuit current at any point in a power system. These are applied *in advance* in specifying the co-ordinated elements that go together to make up a G-E load-center distribution system. A G-E application engineer can make sure that any special conditions within your plant are taken into account.



LOAD GROWTH A FACTOR

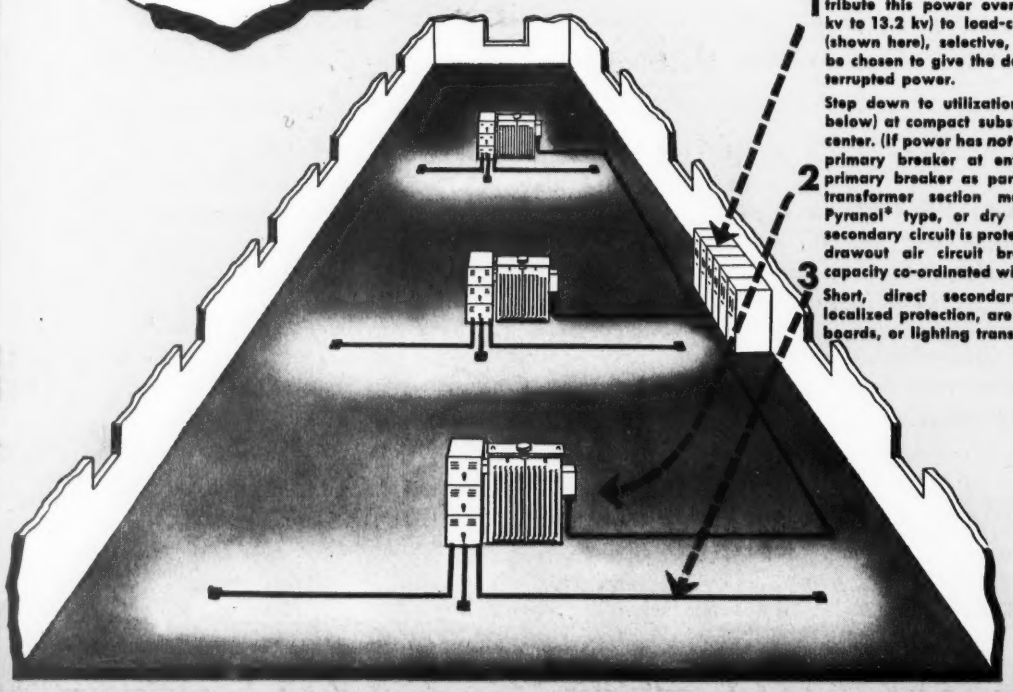
Systems which have been operating for years without a major short circuit often become increasingly vulnerable as load growth raises the capacity of the supply source, and as equipment weakens with age.

*Interrupting Capacity

G-E LOAD-CENTER power distribution affords protection from the dangerous, production-crippling "blow ups" that can result from devices of inadequate interrupting capacity. What's more, the circuit protection for each load area *stays* adequate, despite expansion of your electric system to serve new areas—provided, of course, the system was properly planned originally. Each load-center substation is an individual "road-block" which isolates such short circuits as may occur. Additions to the co-ordinated system can be made without concern as to the interrupting capacity of devices in the localized secondary circuits (where transformers are not in parallel on the secondary side).

War plants equipped with load-center systems have established exceptional records for *uninterrupted* power usage. Now, they are finding that the flexibility of their systems to meet plant changeovers is an equally great advantage.

Before you install any new switchgear, or attempt to revamp outmoded power distribution circuits, switchboards, or substations—better investigate the performance records of G-E load-center installations. Just ask your local G-E representative.



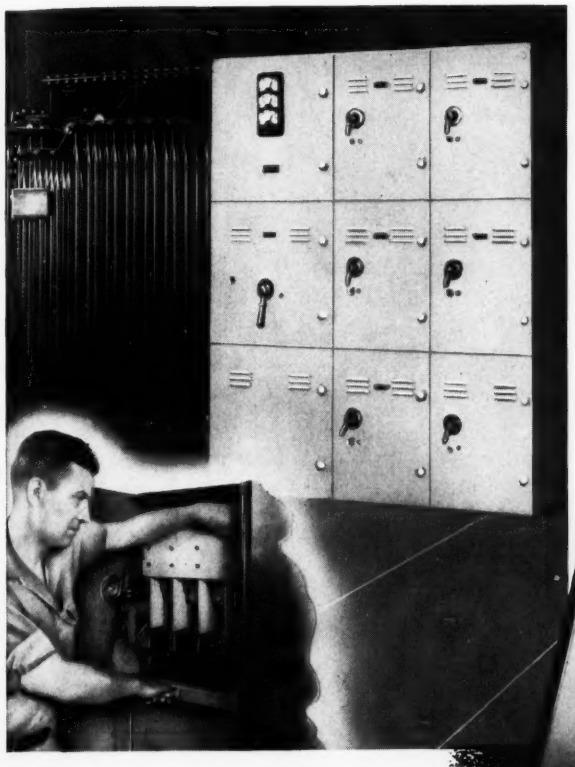
1 Bring in your high-voltage power through a metal-clad distribution and metering panel (or master unit substation if power is purchased at 13.2 kv or above). From primary breakers, distribute this power over high-voltage lines (2.3 kv to 13.2 kv) to load-center substations. Radial (shown here), selective, or network systems can be chosen to give the desired assurance of uninterrupted power.

2 Step down to utilization voltage (600 volts or below) at compact substations right at the load center. (If power has *not* come through *metal-clad* primary breaker at entrance panel, include a primary breaker as part of the substation.) The transformer section may be noninflammable Pyranol* type, or dry type if preferred. Each secondary circuit is protected by a metal-enclosed drawout air circuit breaker, with interrupting capacity co-ordinated with the transformer rating.

3 Short, direct secondary feeders, each with localized protection, are run to equipment, panel boards, or lighting transformers.

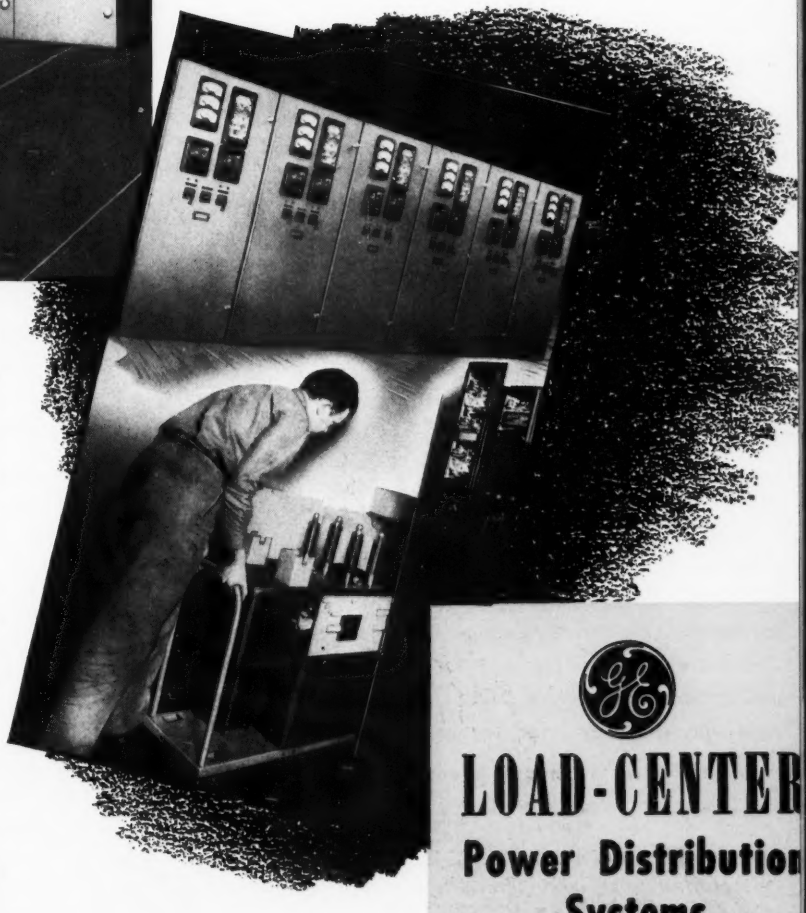
*Reg. U.S. Pat. Off.

CENTER POWER SYSTEM
currents from RUNNING WILD



Key points in load-center power protection are the G-E air circuit breakers, which localize faults in the low-voltage feeder circuits. Their interrupting capacities are *always* matched to the capacity of the transformer.

The draw-out feature simplifies inspection. Interchangeability of breakers cuts circuit-outage time for servicing. Safety interlocks automatically open the breaker upon any attempt to insert or withdraw the breaker while it is in the closed position.



Short-circuit protection of primary plant circuits is best assured by metal-clad switchgear, with magne-blast air circuit breakers, located at the load-center substation, at a central distributing point, or as part of a master unit substation.

Breakers, buses, and other circuit components are completely enclosed within grounded steel compartments that go together to form fully co-ordinated, factory-assembled units. The breakers are of the easily removable and interchangeable type.

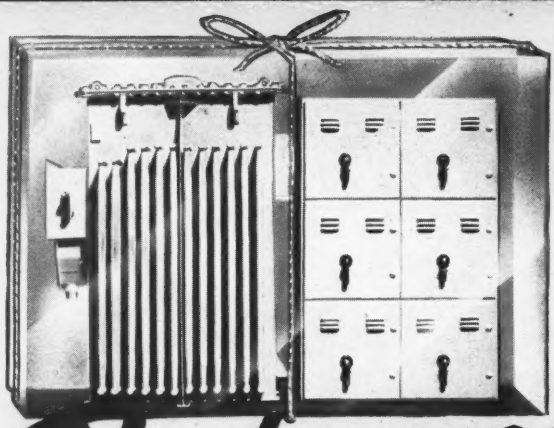
Expansion of your power requirements can be handled by adding units electrically matched to the original installation.

LOAD-CENTER
Power Distribution
Systems

Buy all the BONDS you can—and *keep all you buy*

GENERAL ELECTRIC

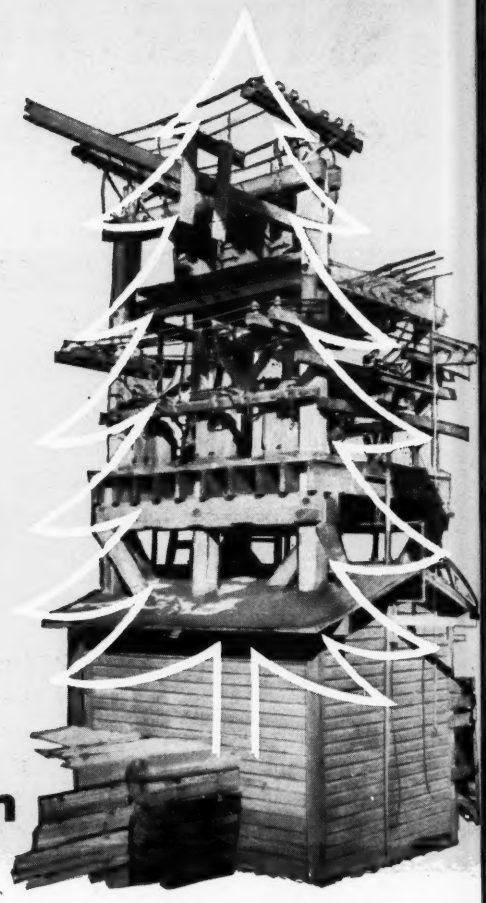
302-32-5900



Packaged Successor

to

Christmas-tree Design



● G-E UNIT SUBSTATION DOUBLES CAPACITY AT LESS THAN REVAMPING COST

When this lumber mill's load increased, the management first considered revamping a piecemeal-built, wooden-tower substation to double its capacity. This meant making room for three 100-kva single-phase transformers and the necessary accessories, although the old substation impeded yard traffic as it was.

A G-E application engineer reviewed the plans. He showed that a new, factory-built unit substation of 300 kva could be installed for less than the revamping cost. Using a Pyranol transformer section it could be installed indoors, with shorter low-voltage feeders, and greater assurance of uninterrupted service. It meant adequate interrupting capacity, and adequate provision for load growth.

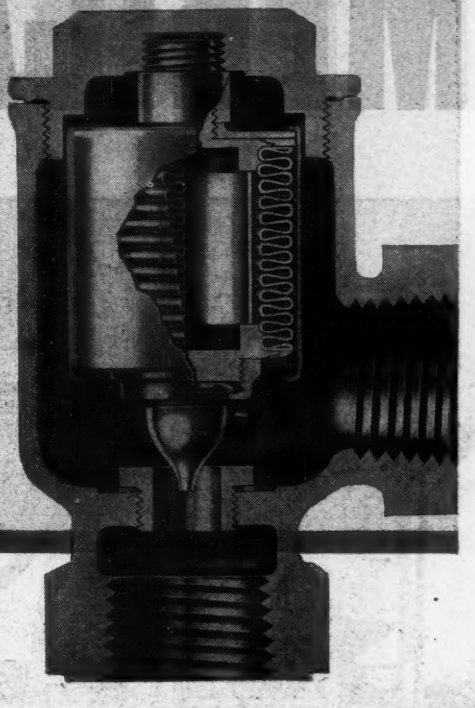
Latest report: "Company is enthusiastic about unit substations and intends to install more."

For complete information on G-E unit substations, see our local representative, or write for Bulletin GEA-3758. General Electric Company, Schenectady 5, N. Y.

UNIT SUBSTATIONS
✓—Safely at home anywhere in the plant, thanks to Pyranol or dry-type transformer.
✓—Interrupting capacity coordinated with transformer rating. Fully metal-enclosed switchgear.
✓—Built to standard designs by repetitive manufacture. Easy to install and maintain.

GENERAL ELECTRIC

MAKE HEAT WORK



Delivery of heat units to the coils is not enough. If condensate clogs them or air is trapped in the coils, heat sits down and waits. If the wrong steam trap is used, heat will escape before its work is done.

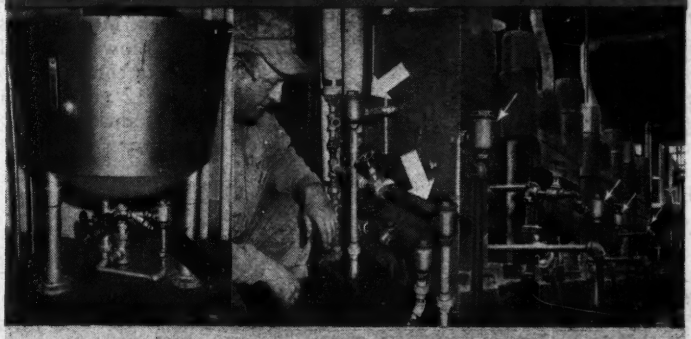
Nor will just any trap do, because there are four kinds, each having a special function. Below we show examples of the No. 9 thermostatic trap used extensively in the heavy heat-consuming industries.

One of these should be used on each coil. They will keep every coil alive, let no unused heat escape. Wide open when cool, they remove air instantly. They cannot stick or freeze. The No. 9 works on all pressures within its range, without seat change.

If your equipment manufacturer did not supply one for each coil, better put them on. Also ideal for air vents. Small, inexpensive, easy to install. Catalog No. 250.

The Sarco No. 9 Steam Trap is a high pressure trap designed especially for process work. More heat is utilized before discharging condensate. The trap works over a wide range of pressures without adjustment. It is ideal for removing both air and condensate from practically all types of steam heated equipment. It is also suited to remove moisture from live steam lines.

CHEMICAL FOOD PLASTICS



Sarco No. 9's on Kettle | *Sarco No. 9's on bottle washer* | *Sarco No. 9's on plastic presses*

31 31

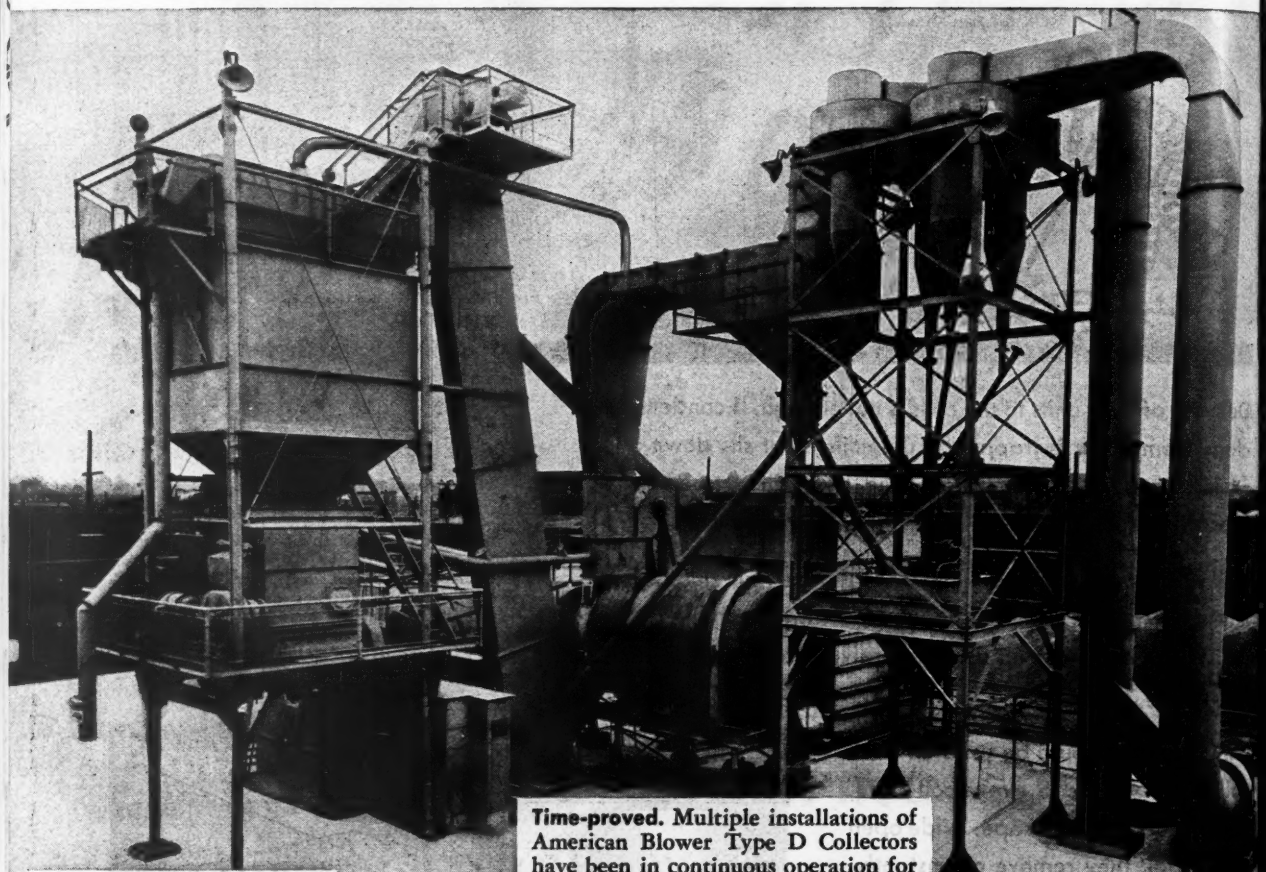
SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

SARCO Saves Steam

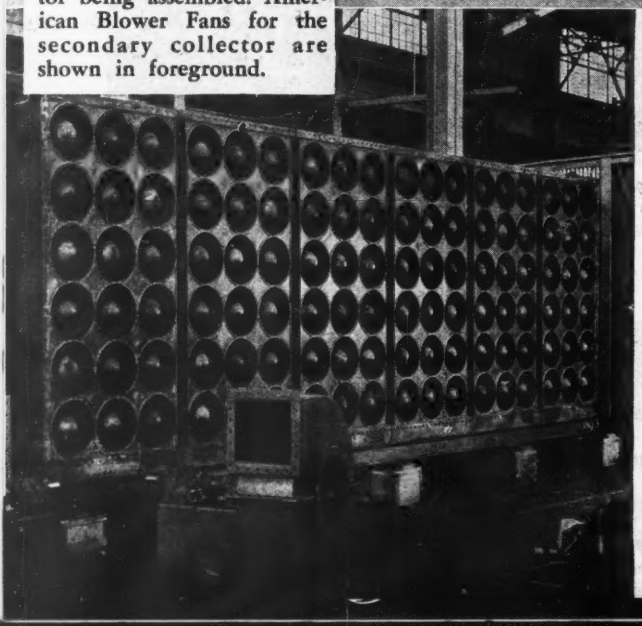
SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

AMERICAN BLOWE D



Time-proved. Multiple installations of American Blower Type D Collectors have been in continuous operation for more than 12 years in asphalt plants and other industries.

Careful assembly. This shop photograph shows a primary American Blower ST Collector being assembled. American Blower Fans for the secondary collector are shown in foreground.



Thousands of dust collector applications covering almost every dust problem known to man, plus the most complete laboratory research facilities in the industry, plus the finest facilities for building and testing collectors, insure complete customer satisfaction of American Blower Dust Collectors.

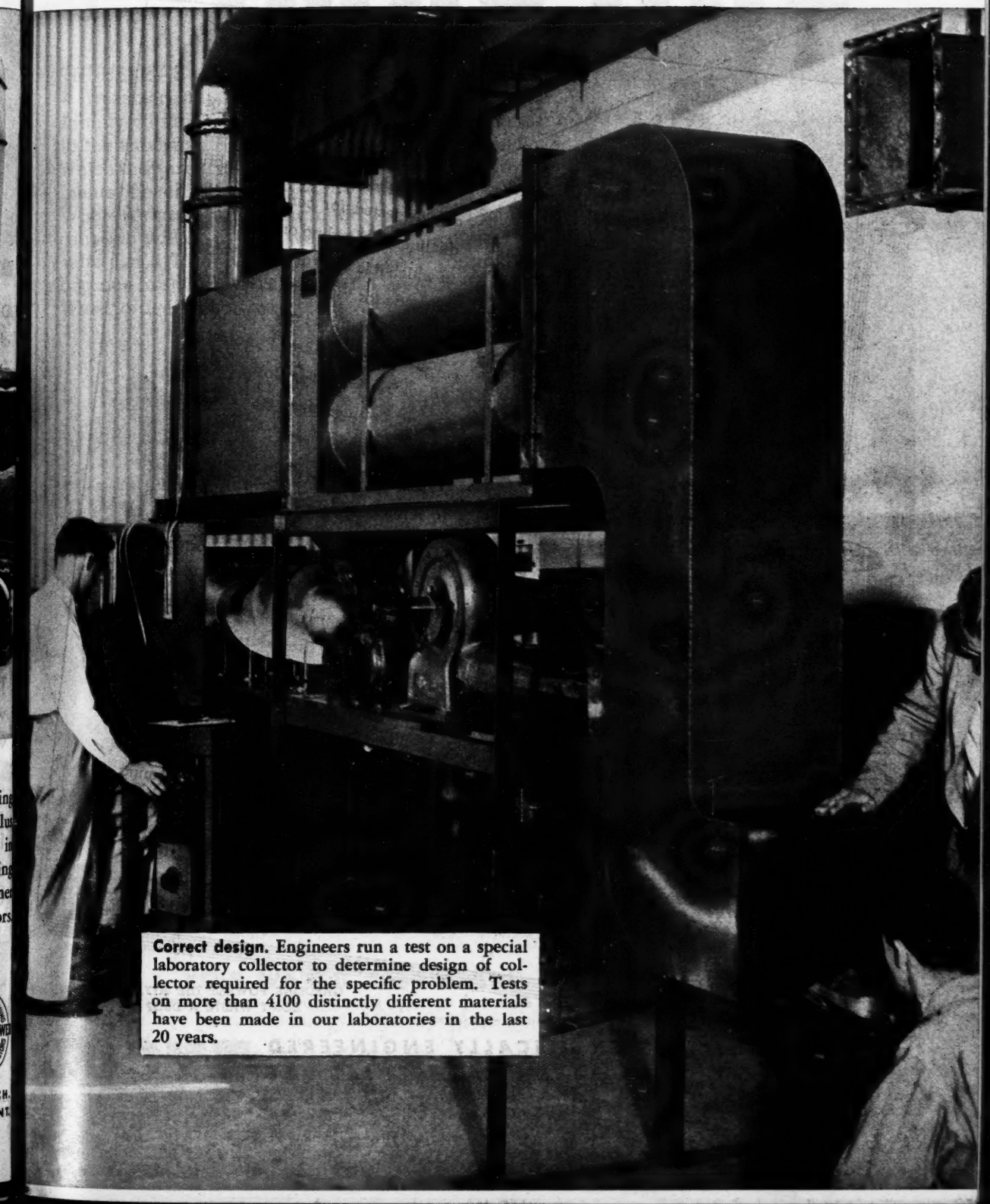
You are invited to inspect our facilities and to bring your dust problem along.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

Division of American Radiator & Standard Sanitary Corporation

DUST COLLECTORS



Correct design. Engineers run a test on a special laboratory collector to determine design of collector required for the specific problem. Tests on more than 4100 distinctly different materials have been made in our laboratories in the last 20 years.

*UNIFORMITY

TIDE WATER LUBRICANIA

DEFINITION: The uniformity of a lubricant is generally understood to mean the conformity in certain specified essential qualities between two or more separate "lots", "batches", or drums of lubricant.

EXPLANATION: In general a slight variation between drums of lubricant in one or more qualities —carbon residue, pour point, specific gravity, etc.—may not have any noticeable effect on the performance of the lubricant. However, if there is a variation in more than one quality—or if the variation occurs in a quality that has a critical bearing on a specific service for which the lubricant is used (i.e., Demulsibility of Steam Cylinder Oils)—then a serious variation in lubricant performance is likely to result.

TEST: There is no single test that can be made to determine uniformity. In practice, each "batch" of lubricant must conform to certain prescribed test limits. The lubricant is tested for certain specific qualities, depending on the service in which it is to be used. Tests may be made for Viscosity, Flash Point, Carbon Residue, Pour Point, Neutralization Number, Penetration, Specific Gravity, Color, or any other pertinent factors.

CONCLUSION: Most reputable refiners and marketers of lubricating oils, greases, and compounds recognize the extreme importance of maintaining uniformity. For this reason their entire manufacturing and testing procedure is scientifically conducted and strictly controlled. Regular testing by skilled technicians, using modern test equipment, provides a further means of assuring the continuing uniformity of each specific lubricant.

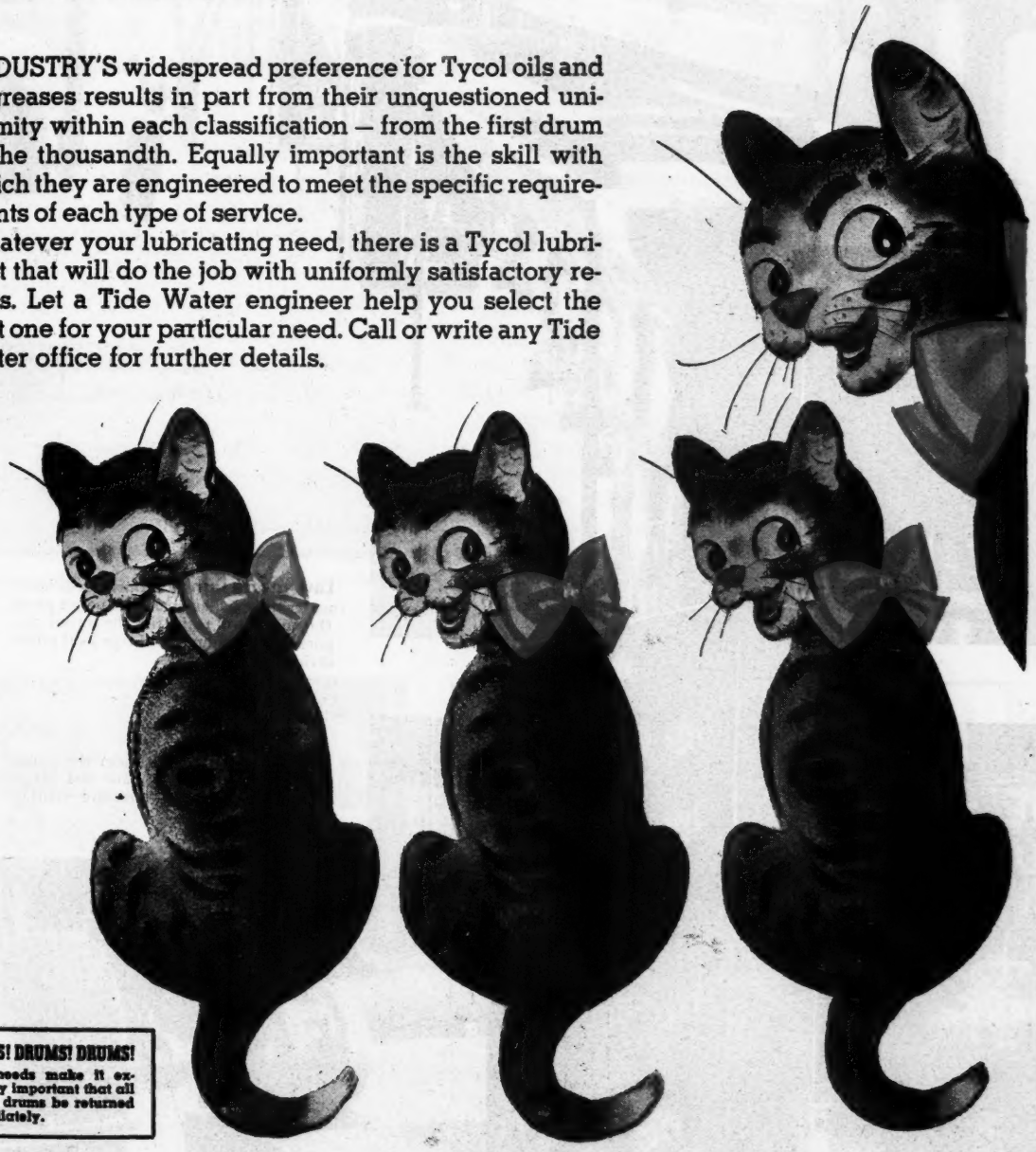
GASOLINE POWERS THE ATTACK—
DON'T WASTE A DROP

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

* This is the 13th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

INDUSTRY'S widespread preference for Tycol oils and greases results in part from their unquestioned uniformity within each classification — from the first drum to the thousandth. Equally important is the skill with which they are engineered to meet the specific requirements of each type of service.

Whatever your lubricating need, there is a Tycol lubricant that will do the job with uniformly satisfactory results. Let a Tide Water engineer help you select the best one for your particular need. Call or write any Tide Water office for further details.



DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

TIDE WATER ASSOCIATED OIL COMPANY

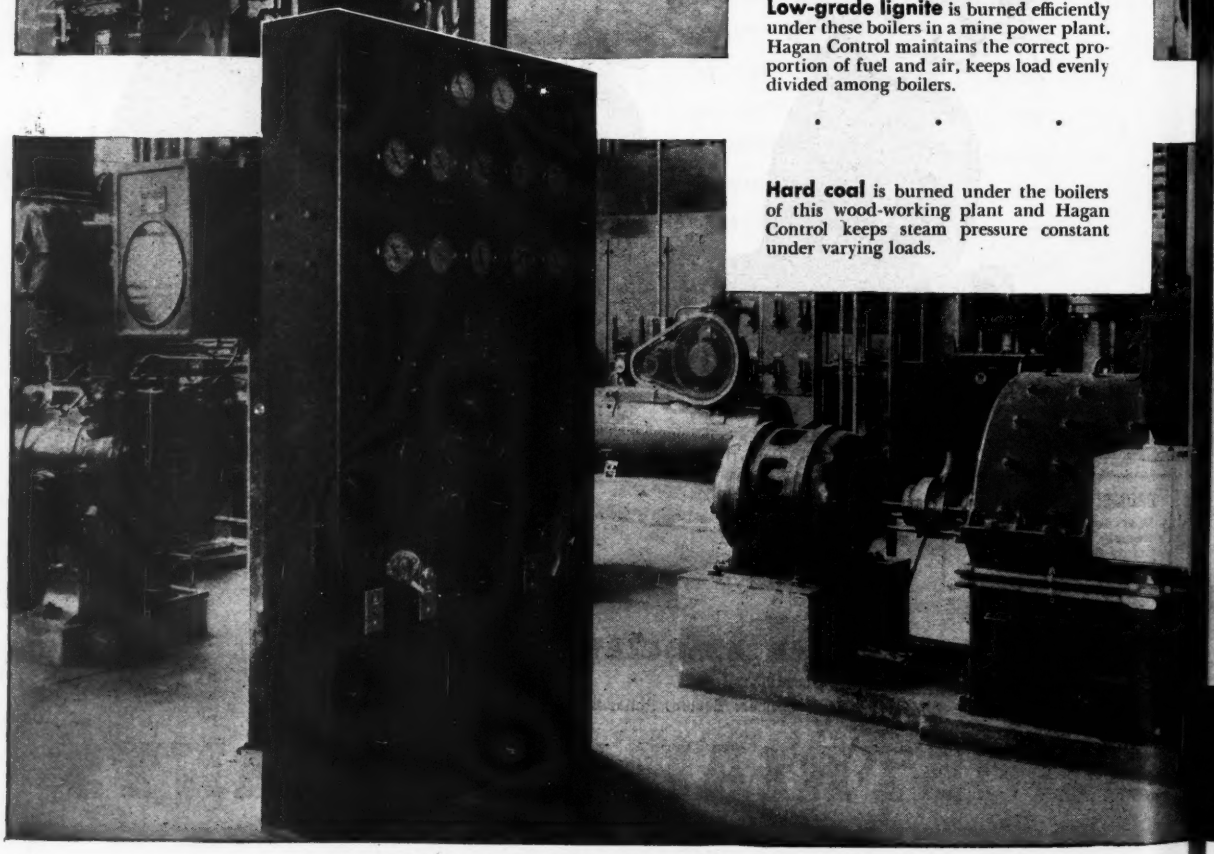
MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

INDUSTRIAL LUBRICANTS

IF YOU BURN COAL, OIL,

Low-grade lignite is burned efficiently under these boilers in a mine power plant. Hagan Control maintains the correct proportion of fuel and air, keeps load evenly divided among boilers.



Hard coal is burned under the boilers of this wood-working plant and Hagan Control keeps steam pressure constant under varying loads.

GAS, TAR ... even sawdust!

HAGAN CONTROL will give you maximum efficiency

THE use of waste materials as boiler fuel serves the dual purpose of saving money for you and of helping the program for the conservation of our natural fuels—coal, oil and natural gas. This has been accepted as standard procedure in some industries for many years, but the possibilities for further savings are to be found in nearly every industry.

Hagan Combustion Control has been responsible for a considerable portion of savings heretofore realized. It was the first system to be used for control of simultaneous firing of multiple fuels—blast furnace gas, coke oven gas and pulverized coal.

Today, the up-to-the-minute version of the same control—engineered to fit into the plant requirements—is ready for application to your problem.

Typical installations are operating with coke breeze as the base fuel and using coke oven gas for auxiliary firing—both controlled automatically.

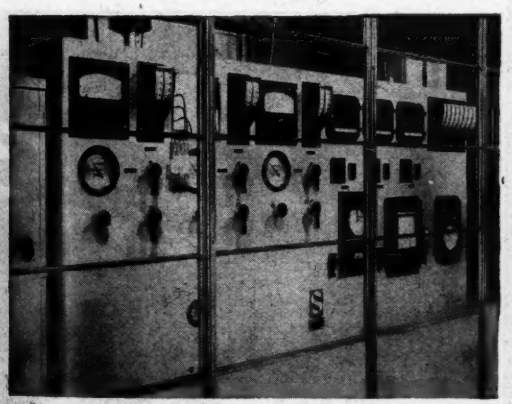
Blast furnace gas is used in other plants, up to the limit of availability, with coal controlled automatically to make up total fuel requirements.

Refinery gas, with a wide range of heat value, is being used with auxiliary fuels—various combinations of fuel oil, natural gas, coal and acid sludge.

Sawdust and hog fuel, with either coal, oil or gas, is a combination coming into wider application.

All of these are controlled economically and efficiently by Hagan Control.

It will pay you dividends to check the possibilities in your own plant—*NOW!* Hagan engineers are ready to help you find the best combination of equipment.



Coke-oven gas or natural gas fires these steel mill furnaces and Hagan Control helps speed up heating.

HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion (for high efficiency.)

MAXIMUM UTILIZATION value and uniform steam pressure.

MAXIMUM OUTPUT from boilers of differing capacities.

MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

Armstrong traps mak

56.25%

LESS BOILER CAPACITY NEEDED

The Midland Chemical Company, Dubuque, Iowa, had placed an order for a new 125 H.P. boiler, but found that the recommendations of an *Armstrong Trap Representative* for a new return system and Armstrong Trapping so increased efficiency they were able to change the order to an 80 H.P. boiler instead!

Fuel oil consumption was cut from 1,500 down to 700 gallons a week.

The boiler room did not have to be enlarged as would have otherwise been necessary.

Faster heating and higher, more uniform temperatures were secured on process equipment.

IT'S A GOOD HABIT TO CALL IN AN ARMSTRONG TRAP MAN IF YOUR PROBLEM HAS TO DO WITH STEAM.

ARMSTRONG *Inverted Bucket*

Boilers Bigger!

When Armstrong Traps replace inefficient drainage devices or old, obsolete traps, the resulting steam saving usually is equivalent to a sizeable increase in boiler capacity. Any engineer naturally will question just how this steam saving is accomplished. The answer is simple.

STEAM TIGHT VALVES. Armstrong valve parts remain steam tight for a long time. This is due to such design and construction features as:

1. Valves and seats are water-sealed at all times.
2. Valves and seats are made of chrome steel. The parts are heat treated after machining. The ball valves are precision ground. Valves and seats are lapped together. Fussy operations, but they pay in steam savings.
3. Free floating lever design lifts valve to seat without leverage, thereby minimizing wear.

AUTOMATIC AIR ELIMINATION. This saves steam in several ways:

1. No manual blowdown necessary to rid pipe or steam heated unit of air.
2. Bypass valves not needed with Armstrong Traps. A bypass valve left open accidentally or on purpose will shrink boiler capacity a lot.
3. By keeping air out of steam heated process equipment, work can be done in a shorter time, thereby reducing non-productive radiation losses.

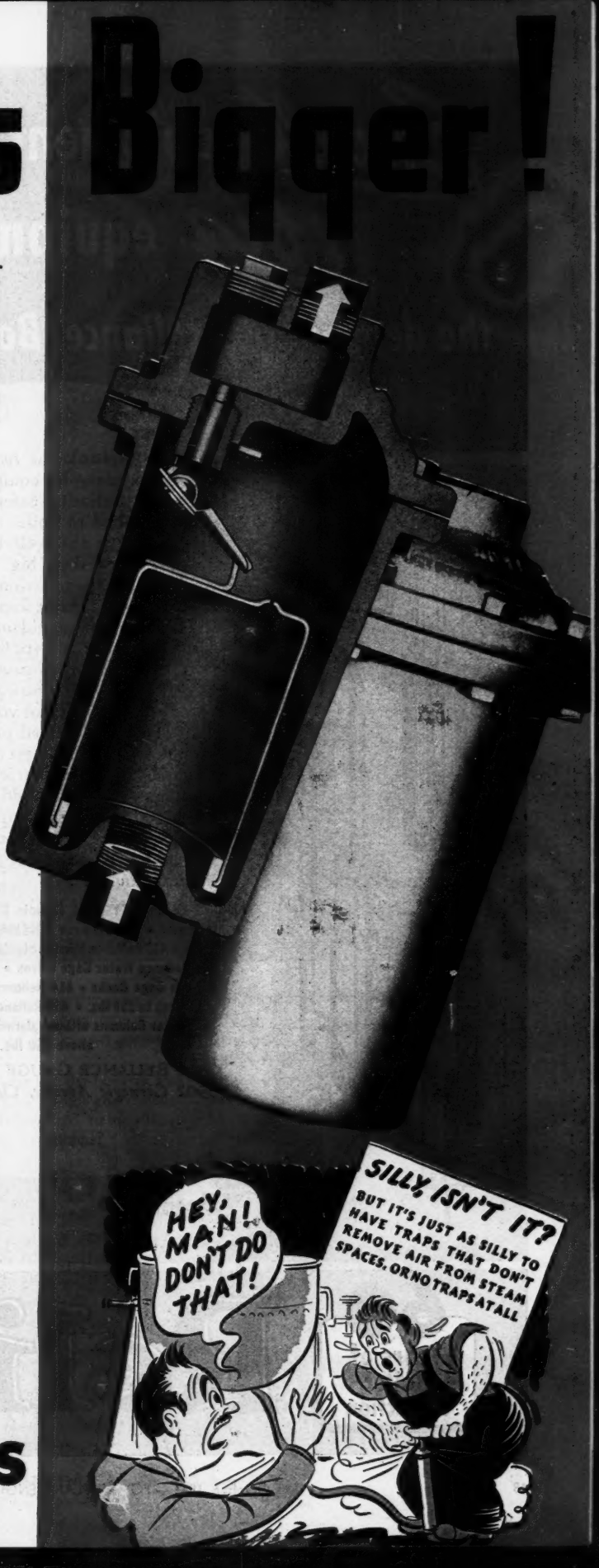
SELF-SCRUBBING ACTION. This saves steam because:

1. It prevents accumulation of dirt which would interfere with trap operation.
2. Dirt will not lodge between valve and seat to prevent tight closing of the trap valve.

Armstrong originated the inverted bucket trap in 1911. For more than thirty years, the Armstrong Machine Works has specialized on making inverted steam traps. During this same period, Armstrong Representatives have specialized on mastering trap selection and installation problems. Call your Armstrong Representative the next time a trap problem rears its ugly head.

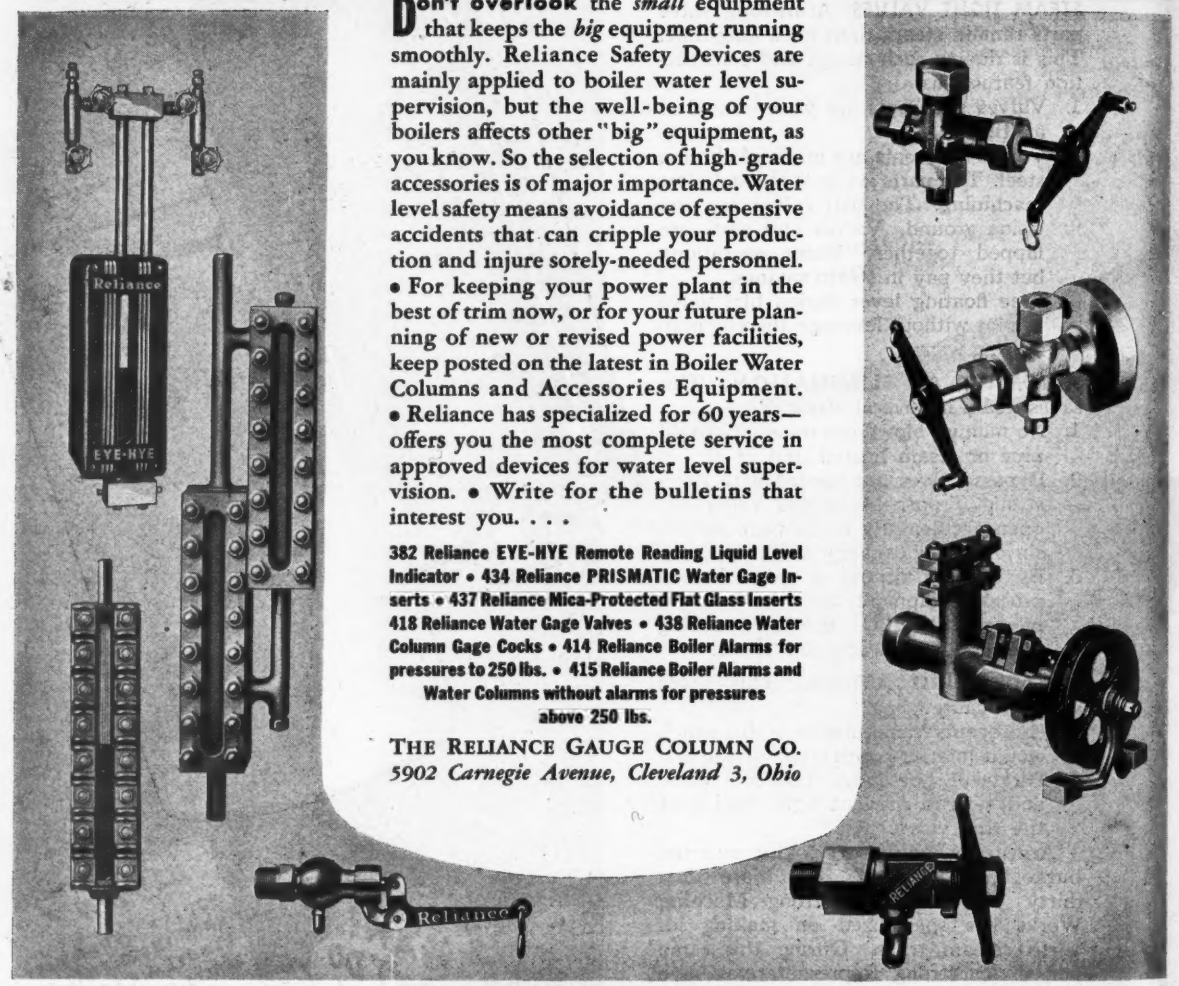
ARMSTRONG MACHINE WORKS
810 Maple St. • Three Rivers, Mich.

STEAM TRAPS


HEY, MAN! DON'T DO THAT!
SILLY, ISN'T IT?
BUT IT'S JUST AS SILLY TO HAVE TRAPS THAT DON'T REMOVE AIR FROM STEAM SPACES, OR NO TRAPS AT ALL

Small equipment that keeps your *big* equipment safe . . .

the dependable Reliance Boiler Safety Accessories



Don't overlook the *small* equipment that keeps the *big* equipment running smoothly. Reliance Safety Devices are mainly applied to boiler water level supervision, but the well-being of your boilers affects other "big" equipment, as you know. So the selection of high-grade accessories is of major importance. Water level safety means avoidance of expensive accidents that can cripple your production and injure sorely-needed personnel. • For keeping your power plant in the best of trim now, or for your future planning of new or revised power facilities, keep posted on the latest in Boiler Water Columns and Accessories Equipment. • Reliance has specialized for 60 years—offers you the most complete service in approved devices for water level supervision. • Write for the bulletins that interest you. . . .

382 Reliance EYE-HYE Remote Reading Liquid Level Indicator • 434 Reliance PRISMATIC Water Gage Inserts • 437 Reliance Mica-Protected Flat Glass Inserts 418 Reliance Water Gage Valves • 438 Reliance Water Column Gage Cocks • 414 Reliance Boiler Alarms for pressures to 250 lbs. • 415 Reliance Boiler Alarms and Water Columns without alarms for pressures above 250 lbs.

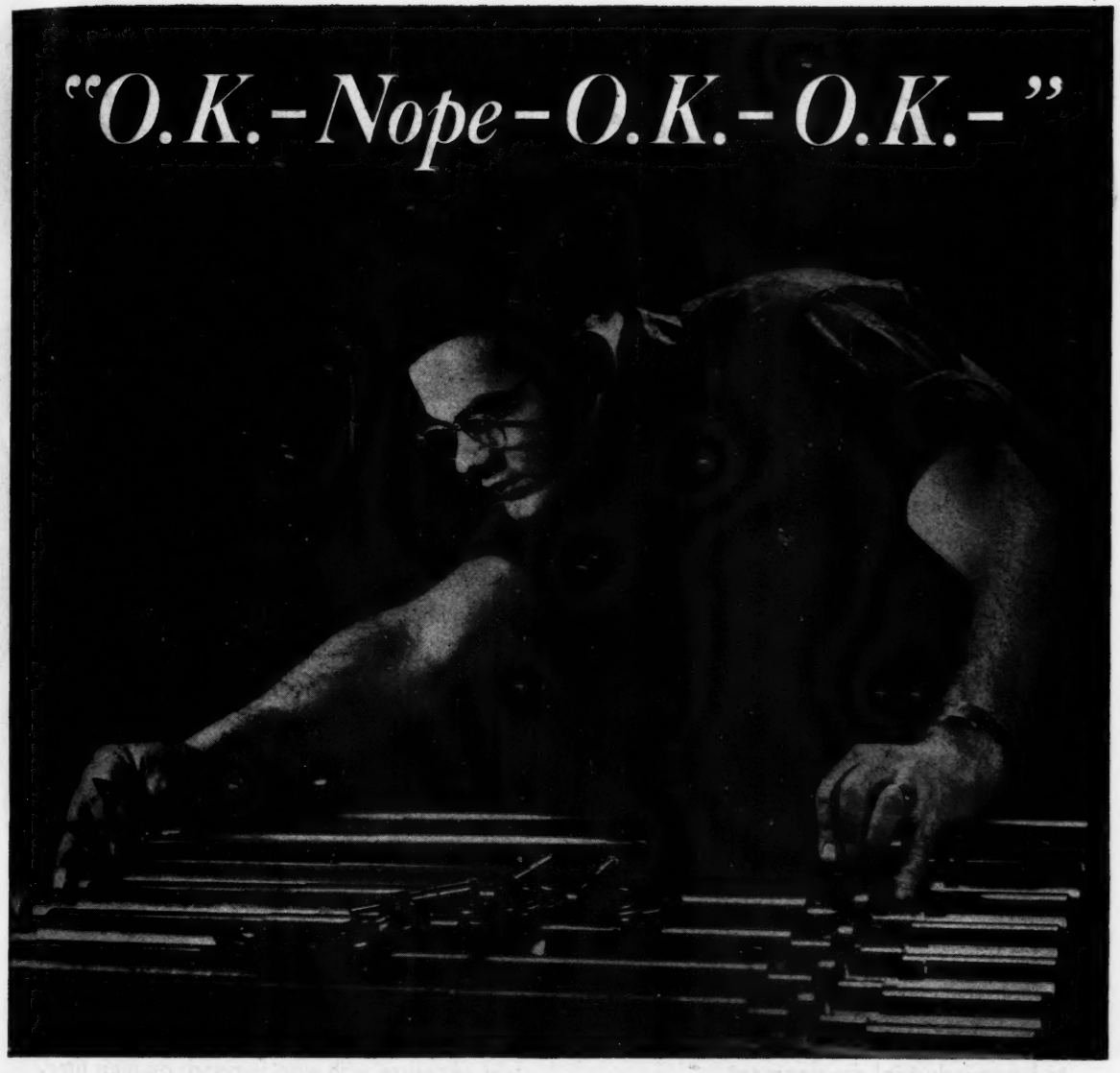
THE RELIANCE GAUGE COLUMN CO.
5902 Carnegie Avenue, Cleveland 3, Ohio

60 Years of Boiler Protection

BOILER SAFETY DEVICES since 1884

Reliance

"O.K.–Nope–O.K.–O.K.–"



TO WATCH HIM operate, you'd think Walter Conner of Allis-Chalmers Norwood Works was conducting a one-man scrap drive.

Not that he finds many defective motor shafts in the course of a day's inspection — but he sure *looks* for them. And when he finds one — bang — it lands on a scrap pile.

In a way, it's the group of motors we *didn't* build that's behind the reputation: "You can depend on Allis-Chalmers Motors!"

But actually, building consistently great motors requires far more than rejecting parts and assemblies that don't come up to Allis-Chalmers standards . . . because there are dozens of points in every motor that *can't be tested* by known methods or instruments.

How can you test the honesty and skill with which a rotor end connection was silver-brazed in depth . . . a hidden coil assembled?

You *can't.*

That's why we're glad Allis-Chalmers craftsmen know today — as they've known for years—that they have a big personal stake in every motor they build for you.

They know that when they build great motors they're making *friends* . . . and that no company and its workers can have too many of them.

Next time you need the kind of extra-quality (but not extra-price) motors Allis-Chalmers builds, check with our nearby district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

• • •

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

AC VICTORY PEACE

A 1727

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

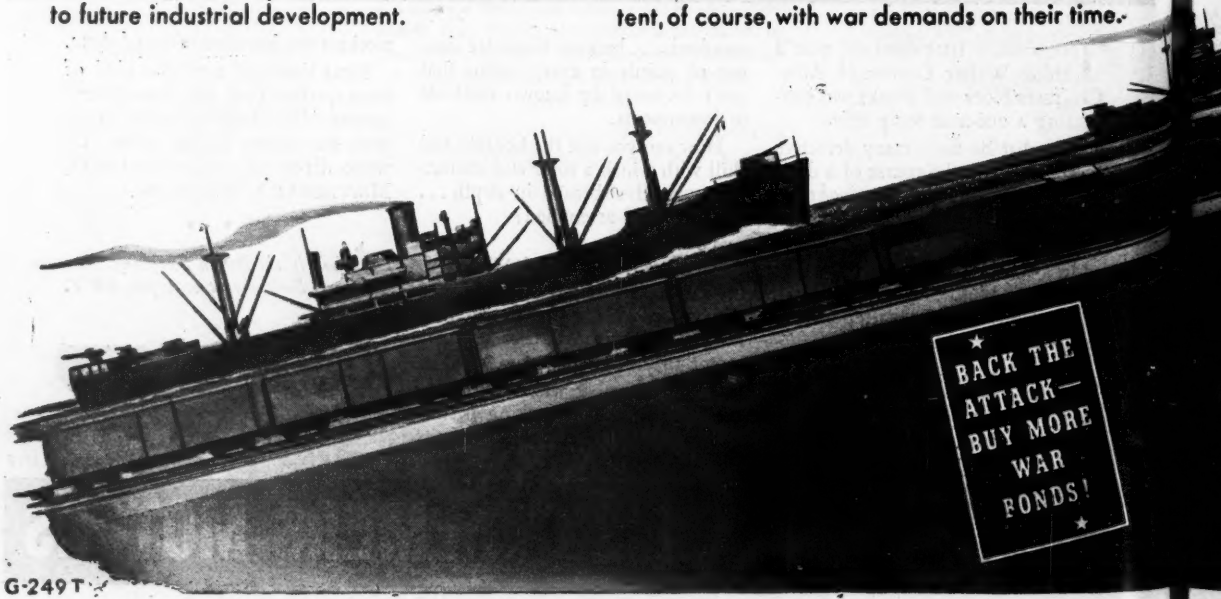
Rebuilding a World for STEAM

The tough tasks of steam plant rehabilitation and development, will fall on engineers who are now serving their country in the armed forces, or in the never-ending battle with power-plant problems in war plants and in public utility plants supplying power to war plants. In this they are applying their engineering knowledge and skills to the early conclusion of hostilities.

When the war will have ended and Victory is ours, these engineers will re-direct their knowledge and skills from war-making activities to the production of steam power for peaceful pursuits, utilizing whatever of their background of war experience is applicable to future industrial development.

We of Babcock & Wilcox have implicit confidence in their resourcefulness, confidence in their ability to continue overcoming almost impossible assignments. Serving other engineers has also kept us on our mettle, as evidenced by important B&W contributions to the continued evolution of practice in steam generation.

While the war effort has first call on your industry's time and resources, you undoubtedly have given some thought to the postwar power-plant problems that will confront you, as it is never too early for engineering planning. B&W engineers will gladly cooperate with you to the utmost of their ability, consistent, of course, with war demands on their time.



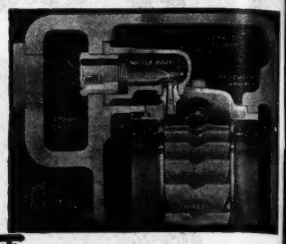
G-249T

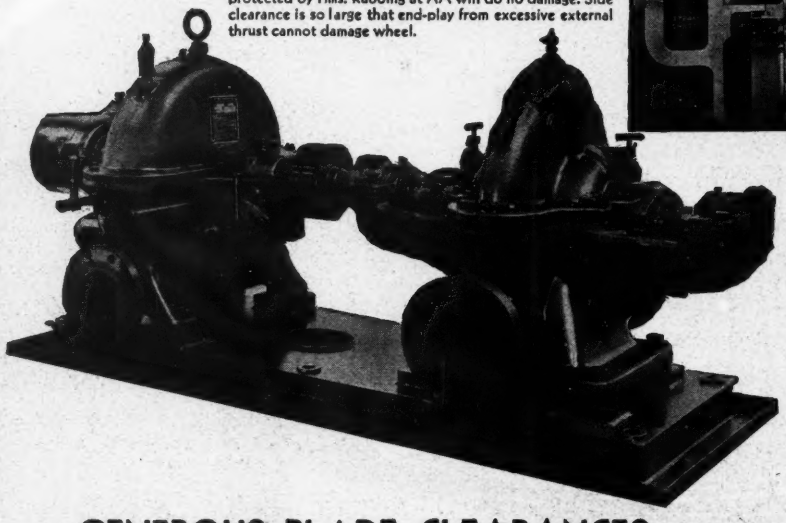
s a Job
THE BABCOCK
85 LIBERTY STREET
NEW YORK 6, N. Y.
& WILCOX CO.

TERRY

DIAGRAM SHOWING WHEEL CLEARANCES

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.





GENEROUS BLADE CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

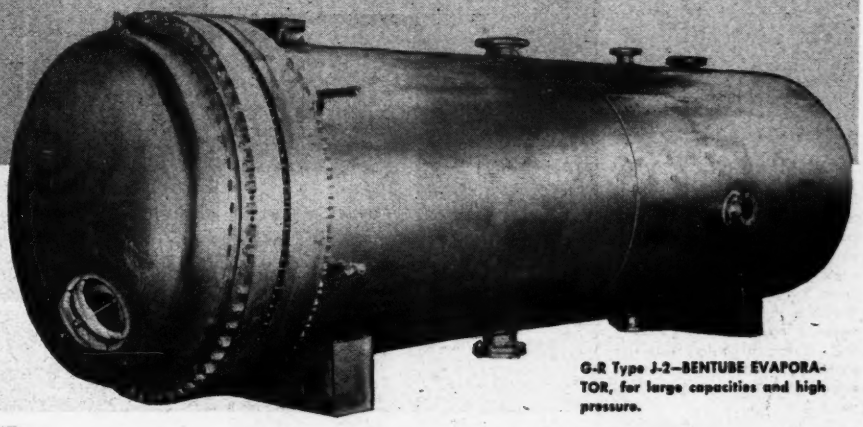
Details of this durable turbine are discussed in Bulletin S-116.
A request on your business letterhead will bring a copy.

T-1155

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

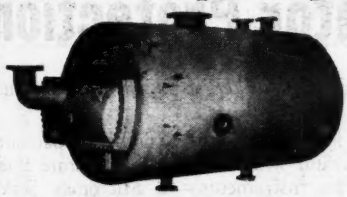
PRESSURE.....HIGH OR LOW

CAPACITY.....LARGE OR SMALL

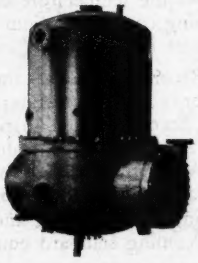


G-R Type J-2—BENTUBE EVAPORATOR, for large capacities and high pressure.

There's a G-R BENTUBE EVAPORATOR for every requirement of boiler feed make-up



G-R Type N—BENTUBE EVAPORATOR, for moderate capacities and low pressure.



G-R Type H — Vertical BENTUBE EVAPORATOR, for small capacities.

No matter what size or type of boiler-feed make-up evaporator may be best suited for your particular plant conditions, an exactly suitable G-R BENTUBE EVAPORATOR is available for your precise requirements.

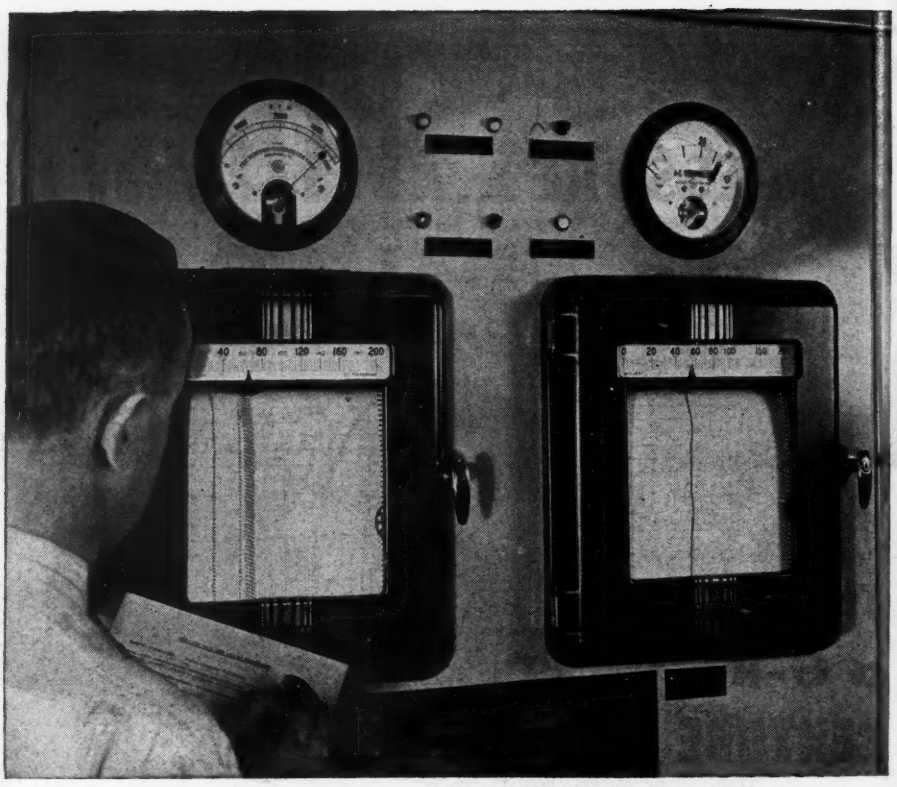
The design of these evaporators . . . based on 75 years of experience in building heat transfer apparatus . . . has several distinctive advantages assuring vapor that is both pure and dry, and with large overload capacity. In addition, these units have exclusive features that *maintain* rated capacity without the necessity of hand-scaling, and provide greatest ease of inspection and minimum attendance.

Bulletin 362 describes G-R BENTUBE EVAPORATORS in detail, explains in what plant conditions evaporators should be used, and analyzes their association with the plant heat balance. Your copy of this informative bulletin will be sent on request.

THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



Micromax Recorder at left shows temperature of 6 points in stator, and also of exciter air and outlet water of the hydrogen cooler of a generator. Recorder at right shows temperature of the field. Watching these 9 temperatures is essential when carrying heavy load, though Recorders will also sound alarms if any one temperature exceeds a predetermined point.

"OVERLOADED" GENERATORS
Need This Micromax Field & Stator Protection

Loading of electrical generators on the basis of the temperatures of their stators and rotors is a practice which many power companies are now planning to use. Special tests have been outlined* to determine the amounts of load which may be added, under specific conditions, to that given as maximum on the nameplate. Here are some of the factors to be considered:

1. Each generator is a separate problem.
2. Nameplate data may provide unnecessarily large safety factor for load swings, unbalanced phases, etc.
3. Ambient temperature may be less than nameplate specifies.
4. Power factor may be higher than specified.
5. Change in terminal voltage may permit greater output.
6. When starting from low temperature a generator can carry short-time excess load because of its own temperature lag.
7. In emergencies and for short peaks it may be more economical to operate at extraordinary temperature and thus age the insulation at an abnormal rate, rather than to provide the additional rated capacity for short-time loads.

When a generator is loaded on the basis of temperature, we can supply its operator with complete temperature readings by means of two instruments — a Micromax Stator Temperature Recorder and its companion, a Rotor Recorder.

The Stator Recorder shows the temperature of 6 points, and of incoming and outgoing cooling medium. It sounds an alarm if a peak temperature is reached.

The Rotor-Temperature Recorder measures the resistance of the entire field and records it as temperature. Devised about 15 years ago, it has been less used than the Stator Recorder, for the reason that not every generator normally needs both instruments. As load becomes abnormal, or unfavorable power factor conditions occur, however, this instrument has come increasingly into use and under present-day conditions is rapidly becoming standard equipment for large generators.

Both instruments are described in Catalog N-33-161, available on request. If you have a specific instrumentation problem in mind, please describe it and an L&N engineer will gladly try to help solve it.

* From AIEE Miscellaneous Paper 43-93, "Interim Report on Emergency Measures to Increase Output of Generating Equipment and Systems", June 1943, available at 65c from AIEE, 33 W. 39th St., New York City.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

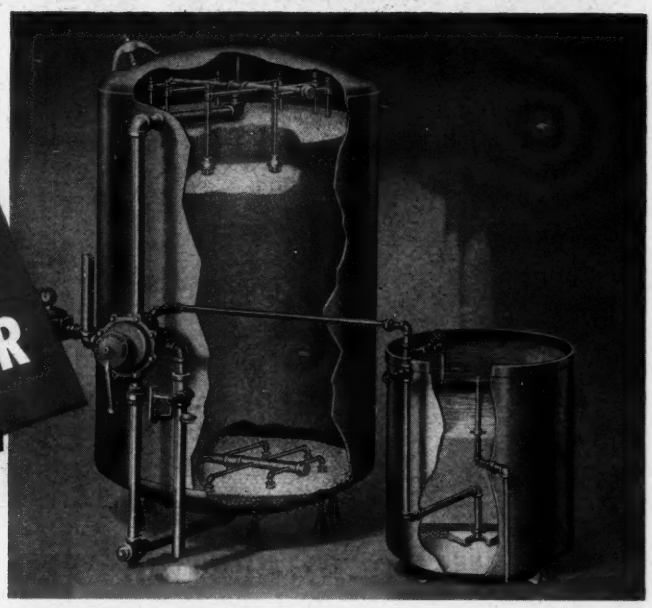
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33-161 (5)

NOW AVAILABLE

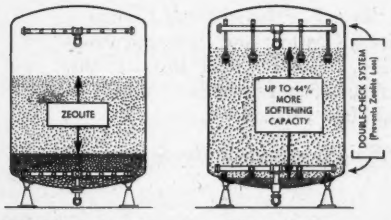
postwar design

ELGIN WATER SOFTENER



. . . delivers up to 44% more soft water

NOTE THE INCREASED CAPACITY



ORDINARY WATER SOFTENER DESIGN

ELGIN WATER SOFTENER DESIGN

HERE'S HOW TO STEP UP THE OUTPUT OF YOUR PRESENT WATER SOFTENER

The "Double-Check" equipment can be installed in place of the present manifold in your zeolite softener regardless of make. This change, along with Elgin High Capacity Zeolite, will give you greatly increased soft water output. The cost of this modernization is surprisingly low. Let us give you facts.

• Here's real news for users of zeolite water softener equipment. Our postwar design is now available. It delivers up to 44% more soft water than any other unit of equal size. Of importance is the fact that this new water softener has been fully proved by gratifying results in a long list of plants where it is already in service.

An improved double-check type manifold prevents the escape of zeolite and therefore permits placing a far greater amount of water softening zeolite in the softener, as shown. More zeolite means more soft water output—for it's the zeolite that does the softening.

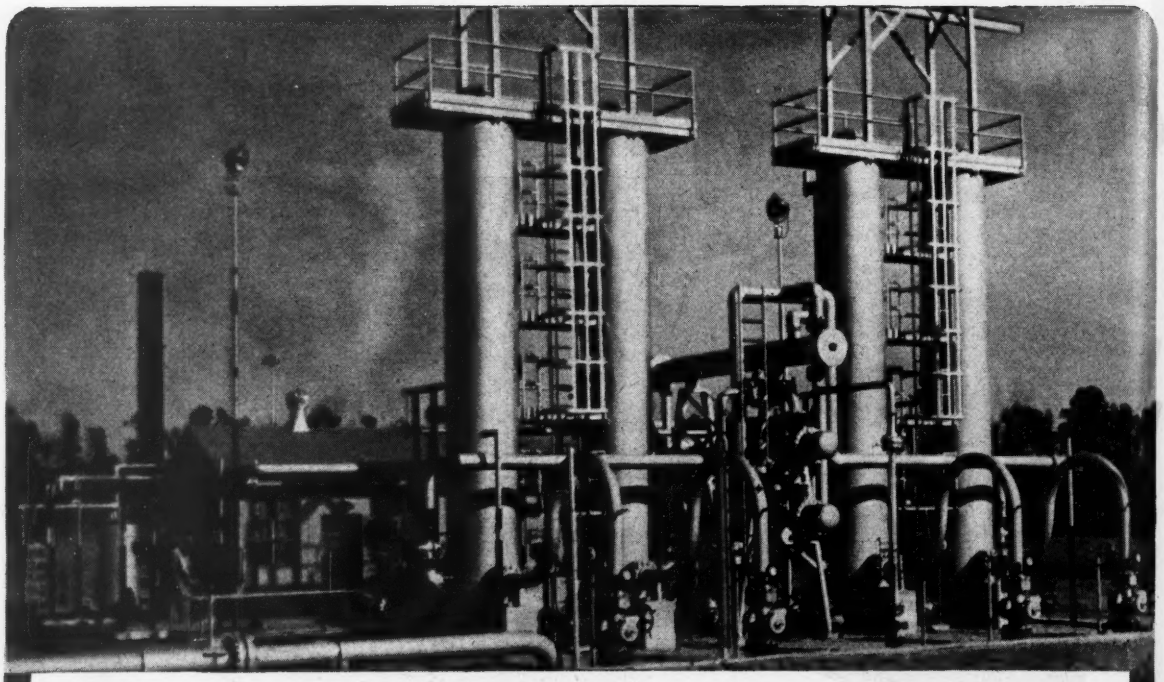
But that isn't all. A higher backwashing rate is also made possible by preventing loss of zeolite. This higher rate cleans the softener thoroughly. With the zeolite bed clean, the salt reaches every grain of zeolite. The result is better regeneration with less salt consumption . . . higher over-all efficiency.

The whole story of tomorrow's water softener today is told in brand new bulletin 606. Write for your copy today.

ELGIN *economical water conditioning*

The complete Elgin line—Boiler Water Treating and Purifying Systems • Feedwater Treatment • Deconcentrators • Heat Exchangers • Water Softeners • Filters and Purifiers • Iron Removal Equipment • Aerators • Water Treating Chemicals • Chemical Feeders • Scale and Corrosion Inhibitors • Sample Coolers • Water Testing Equipment • Zeolites

ELGIN SOFTENER CORPORATION, 136 NORTH GROVE AVENUE, ELGIN, ILLINOIS

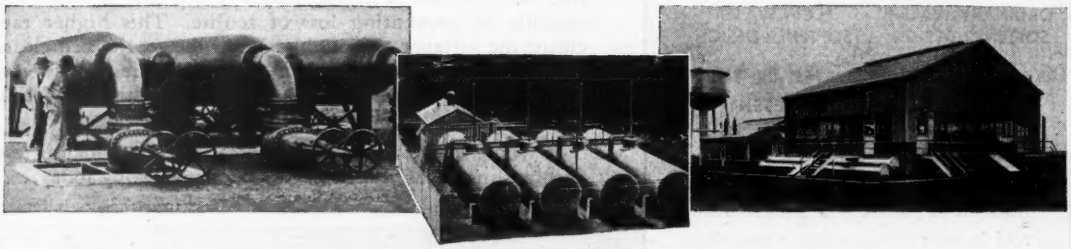


EQUIPMENT TO CONTROL AND PROCESS NATURAL GAS DESIGNED, ENGINEERED and CONSTRUCTED

Having engineered through to completion and operation a number of the natural gas industry's handling and treating projects, J. F. Pritchard and Company, through its *Natural Gas Division*, is competently prepared to cooperate with you in your particular problems. The experience and knowledge of Pritchard engineers assures you of obtaining the proper equipment for the job to be done.

Among the units designed, engineered and constructed by the J. F. Pritchard and Company *Natural Gas Division* are: Compressor Stations and Additions, Gas Lift and Pumping Problems, Gas and Air Dehydration, Conditioning and Treating, Stand-By Fuel Installations, Hydrocarbon Dew Point Control Plants, Scrubbers, Cleaners and Separators, for removal of dirt and liquids from Gas, Air and Steam, Gas Coolers, and Heat Exchangers.

J. F. Pritchard and Company, *Natural Gas Division,* Fidelity Building, Kansas City 6, Missouri



KANSAS CITY
TULSA
CHICAGO

Pritchard

HOUSTON
NEW YORK
PITTSBURGH

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

EXAMPLE OF *Service*:

A chain of 150 motion picture houses was having consistent trouble with its power equipment. Many experts tried to correct it and failed... then one of our Cities Service Lubrication Engineers tackled the problem. With the exclusive Cities Service *Industrial Heat Prover* he analyzed combustion... made necessary adjustments. In the two years since, these plants have shown greater efficiency, lower operating costs.

More and more, it's service that counts...

and *Cities Service* means good service!

CITIES SERVICE OILS
ONCE-ALWAYS
CITIES SERVICE OIL COMPANY
ARKANSAS FUEL OIL COMPANY

Designed especially for HIGH-SPEED Centrifugal Pumps!

HIGH-SPEED centrifugal pumps require a packing that can "take it." Johns-Manville Spiral Plastic Packing, for example. Tests prove this packing has been remarkably successful in such service. And there's good reason why . . .

Johns-Manville Spiral Plastic Packings are made of selected asbestos fiber combined with such materials as non-friction metal, graphite, mica, lubricants, and binding compounds. These materials are thoroughly mixed together into a homogeneous composition, which is formed into spirals of the proper density and uniform cross-section by extrusion through steel dies. Spiral Plastic comes in sizes of ¼" and up, any one of which can be used for cutting rings to fit rods of various diameters.

A number of styles of J-M Spiral Plastic Packings are available, each designed for a particular use, such as No. 620 for oil, Nos. 640 and 645 for acid, No. 630 for food, and Nos. 610 and 615 for general service. For details, write Johns-Manville at 22 East 40th Street, New York 16, N. Y.

Advantages of Johns-Manville Spiral Plastic Packing

- Uniform density and cross-section
- Each style compounded for a specific service
- Easy installation
- Low friction
- Eliminates need to stock many sizes of rings

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

THERE'S A J-M DISTRIBUTOR NEAR YOU

OFTEN

This

is the Practical Way To Elevate Coal

Demonstrating That There's No Single Solution to All Coal Handling Problems

What is the best way to handle coal at a power plant—belt conveyor, bucket elevator, enclosed conveyor-elevator, skip hoist?

In the case shown, the skip hoist does the bulk of the work. Its selection as the most practical of the many types of elevating equipment available was based on a thorough study of all the problems involved at this specific plant. As a result, coal is being handled rapidly at low cost per ton.

What this example emphasizes is the fact that each handling problem calls for a specific answer. That's the reason you are urged to lay your problems before a competent, unbiased jury of experts—the S-A engineering staff. With access to *all* types of conveying and elevating equipment (all made by S-A), they are in a position to recommend the exact system you need for utmost handling efficiency. Write us today for the whole S-A story.

This photo shows a power plant, coal handling system consisting of a double bucket skip hoist, a pan feeder and belt conveyor, all of which were furnished by Stephens-Adamson.

STEPHEN S-A ADAMSON
MFG. CO.

618 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

Ductility

...AND ITS OVERALL IMPORTANCE IN AN ENGINEERING METAL

In general terms, ductility is the property of a metal that permits it to be deformed without fracture.

It is the exact opposite of brittleness.

If two materials have the same strength and hardness, the one with greater ductility has a good chance of holding up under overloads which would snap the other.

Thus, ductility is especially important in bolts, where strain is likely to result from too vigorous tightening or from abrupt temperature changes. It also is an essential property in metal gaskets. A strong, ductile gasket will adapt itself readily to imperfections in joint surfaces while maintaining the strength necessary to prevent leakage.

And, finally, high ductility is a great advantage in fabrication. The more ductile the material, the more easily it can be handled by the usual cold-working methods... bending, deep drawing, spinning, cold heading.

Strength and Ductility

By the very nature of materials, strength and ductility are divergent properties. As one increases the other decreases. As a general rule, highly ductile metals are soft and weak; some high strength metals are hard and comparatively brittle. But one of the outstanding characteristics of INCO Nickel Alloys is their exceptional combination of strength with high ductility.

How Ductility is measured

There are several methods for testing the ductility of metals, but the most common method is to pull a specimen of the metal on a tensile testing machine until it breaks. The ductility of the metal is then determined by measuring how much the specimen "stretched" or elongated.

This is the method which was used in measuring the strength-ductility of Monel and other metals as shown in the charts below.

What the charts show

In Fig. 1, showing tests made by R. L. Templin and R. G. Sturm, the top point of the curve indicates the tensile strength of the various metals. Ductility... as evidenced by the metal's "stretch"...is shown by the horizontal carry of the curve to the point where it drops off sharply.

Fig. 2 shows the results of strength-ductility tests with ⅜" diameter bolts of Monel, brass, bronze and steel, as determined at Columbia University, New York City. This test shows the high value of Monel for bolts and similar applications.

Spun Monel diaphragms

Stronger than mild steel, Monel is ductile enough to be formed in the most severe of all metal working methods... spinning.

Diaphragms for gas meters and gas analysis instruments are spun from Monel, as illustrated in the accompanying photo.

Ductility makes the spinning process easier... the combined strength, hardness and corrosion resistance mean longer life for the finished Monel part.

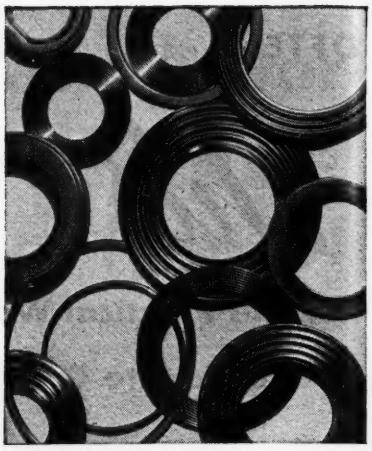
Gaskets for high temperatures

Typical Monel gaskets for lines carrying steam at high pressures and at temperatures over 500° F. are illustrated also. Since Monel is stronger at 1000° F. than mild steel is at room temperature, thinner and narrower gaskets can be used. Thus, stresses on flange bolts can be reduced considerably. Yet, despite its strength, Monel is so ductile that a gasket shapes itself to slight imperfections in the flange faces as the bolts are tightened, forming a sealed joint that stays tight at high pressures. Alternate heating and cooling do not embrittle Monel gaskets... ductility remains at a high level.

• • •

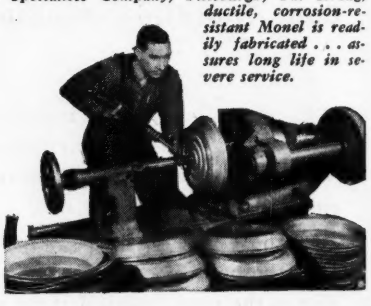
For further information about ductility and other properties of metals, write for the booklet, "The Technical Editor Speaks." A copy is yours for the asking. Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall St., New York 5, N.Y.



HIGH-TEMPERATURE HIGH-PRESSURE STEAM *line gaskets formed from Monel by Goetze Gasket & Packing Co. Combined strength-ductility of Monel permits thinner gaskets, saving stress on bolts. Monel gaskets adapt self to joint surfaces... assure strong, tight, lasting seal.*

SPINNING MONEL DIAPHRAGMS *for gas meters and gas analysis instruments at Schwab Specialties Company, Pittsburgh, Pa. Strong, ductile, corrosion-resistant Monel is readily fabricated... assures long life in severe service.*



TENSILE STRENGTH-DUCTILITY CURVES
FOR SOME METALS AND ALLOYS

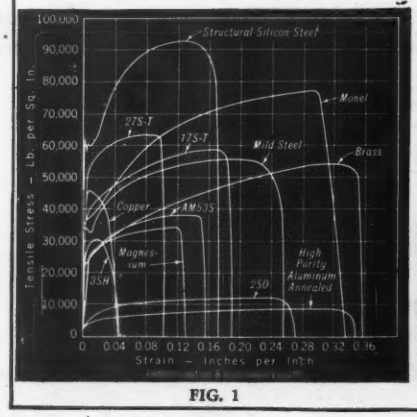


FIG. 1

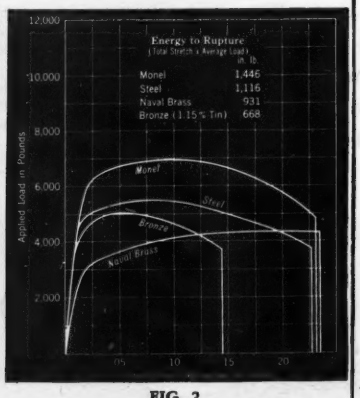
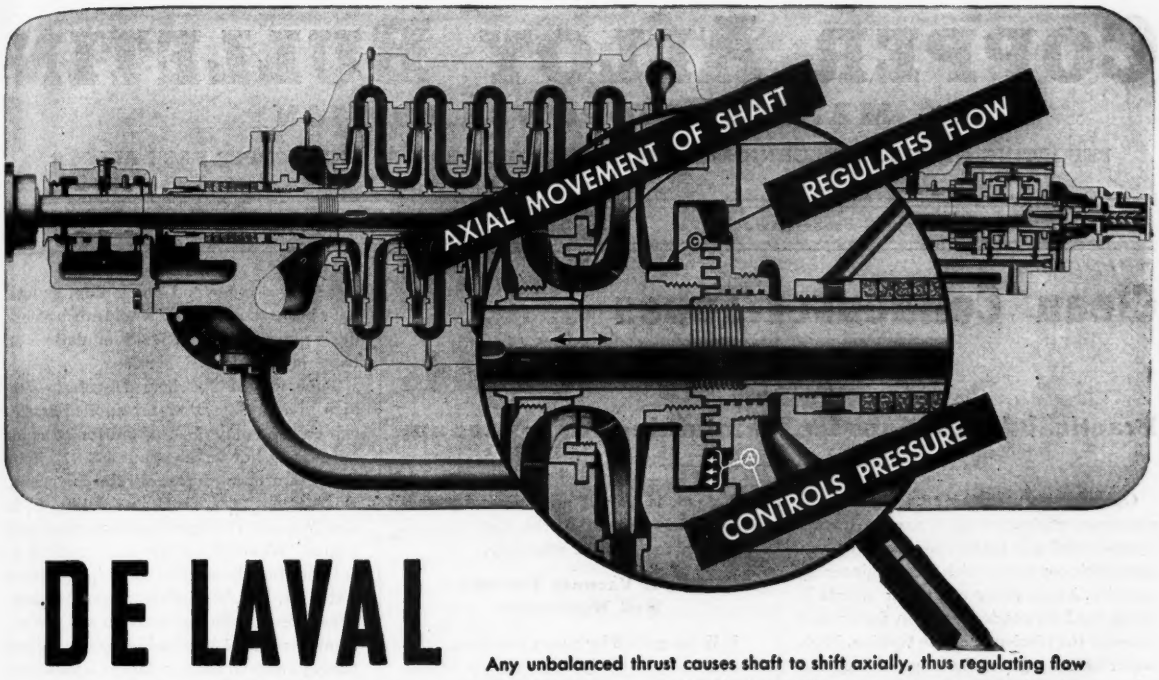


FIG. 2



DE LAVAL

BALANCING ARRANGEMENT *Automatically* BALANCES ALL THRUST

Any unbalanced thrust causes shaft to shift axially, thus regulating flow through clearance C, thereby controlling pressure against balancing disc A and thus automatically returning the pump to a state of perfect balance. Note that this hydraulic device leaves no unbalanced thrust to be taken up by bearings or other metallic contacts subject to wear.

ELIMINATES SOURCE OF TROUBLE IN HIGH-PRESSURE BOILER FEED PUMPS

The erosive action of high-temperature feed water in a high-pressure boiler-feed pump does not interfere with the operation of the De Laval automatic hydraulic balancing arrangement, since the automatic action of this device is in no way affected by normal wear, as can be seen from the illustration. Its universally trouble-free performance has been demonstrated over a period of 30 years in hundreds of installations, handling feed water up to 350° F. and discharging against pressures up to 1600 psi.

3630

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Clean Condenser Tubes Pay Big Dividends

Practical Suggestions for Maintaining High Vacuum

Operators naturally are anxious to obtain maximum efficiency from their power plants by maintaining as high a condenser vacuum as possible consistent with good engineering practice. More water at greater speeds is being used to condense steam faster and increase the efficiency of the turbine. High water velocity generally helps to keep the tubes clean. However, vast quantities of water rushing through the condenser increase the corrosion problem along certain lines. To counteract the corrosion accelerating effects of high water velocity, turbulence etc., Cuzinal, Duronze IV and Bridgeport's 70-30 Cupro Nickel are used in place of Admiralty.

The accumulation of films of slime and dirt, on the other hand, accelerate corrosion of condenser tube alloys by deposit attack and at the same time reduce heat transfer appreciably. These factors, of course, have a direct bearing on the successful operation of the entire power plant. Condensation of the steam is slowed up, and it becomes impossible to maintain the high vacuum necessary for greatest efficiency.

Slight Vacuum Increase Well Worthwhile

It is recognized by power plant engineers that a comparatively slight change in condenser vacuum of even 0.1 inch can make a difference of hundreds and even thousands of dollars per year, depending upon the size of the power plant involved.

How to Keep Tubes Clean

There are several methods of maintaining clean condenser tubes. Chlorine, chlorine and ammonia, or certain salts injected into the circulating water periodically or continuously have prevented certain slime conditions in connection with marine growths, and in some cases have made regular plug cleaning unnecessary. Chloramine solutions made by dissolving equal parts of bleaching powder and ammonium sulfate have been recommended where much chlorine is required to kill the accumulations of bacteria and algae.

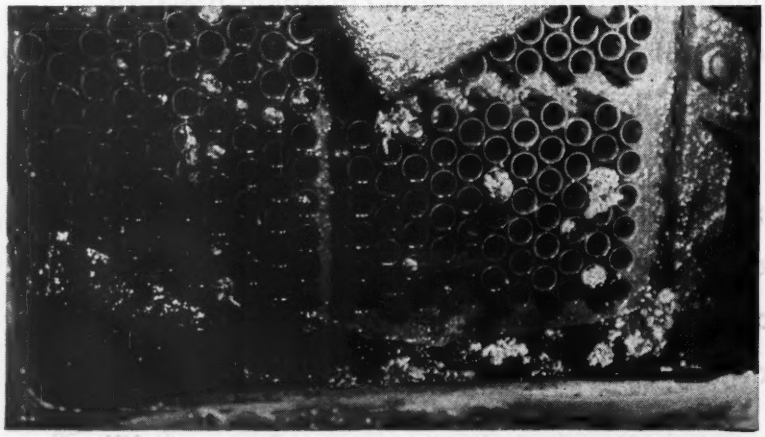
Tubes may also be cleaned regularly with high pressure air or water applied at the exit end and may be dried out for 24 hours by passing hot air at about 120° F. from the generator air ducts into the condenser, while steam at approximately 140° F. is slowly passed through the steam space and vented. When tubes are thoroughly dry, each one may be washed by a high pressure water jet. If it is possible to open the condenser for a sufficient time to kill the accumulated deposit of slime by drying out through normal air circulation, heat transfer properties may be restored without resorting to chemicals.

Additional Things You Can Do

Then, of course, there is the well known "plug" method which consists of pushing rubber plugs through the tubes. This is very effective if done regularly on schedule. Incidentally, wire brushes should never be used as they disturb the protective scale by abrasion.

Clean condenser tubes are desirable, not only from the standpoint of economy and operating efficiency, but also in the interests of conserving vital equipment. Listed below are some additional suggestions for keeping condensers free from dirt and debris and increasing their efficiency and life.

- Dredge channel and keep intake tunnel clean.
- Use screens fine enough to prevent debris from entering the condenser tubes.
- Check all valves, bonnets, and glands to prevent air from entering water stream.
- Use a device on water box, such as an air-venting system (air and erosion eliminator) for expelling entrained air.
- Clean out water box and keep the paint intact.
- Wire brush zinc protection plates and tighten bolts regularly in water box.



Slime accumulation on tubes and in water box of condenser using semi-tropical sea water.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

ESTABLISHED 1865

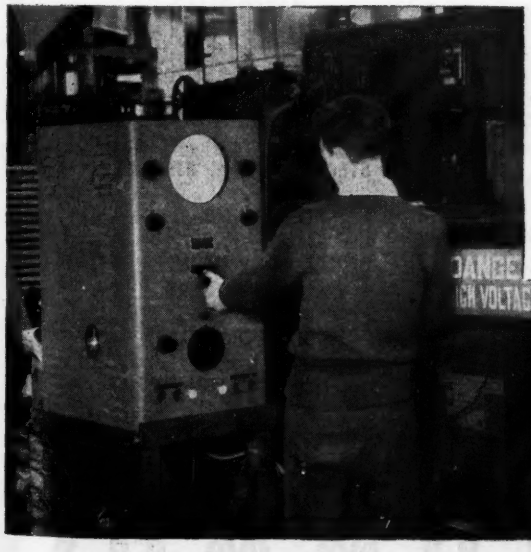
SHORTS STYMIED

Voltage surges which accompany switching and frequent starting and stopping of motors impose high dielectric stresses on the coil insulation, and can cause harmful short circuits. Yet this is an unavoidable condition of service for many motors.

The grinder shown here, for example, starts and stops every time a finished part is removed and a new part inserted. But the two Tri-Clad motors that drive it have been built to withstand safely the voltage surges ordinarily encountered in this type of service. Their ability to "stymie" shorts was proved by the new *General Electric test* described below.

External grinder, equipped with two Tri-Clad motors, installed in the milk-machinery manufacturing plant of the Rite-Way Products Company, Chicago, Ill.

New high-potential, electronic surge-tester verifies strength of TRI/CLAD motor windings



This electronic test of insulation makes a "cardiogram" of every Tri-Clad motor winding, ferreting out weaknesses that might lead to shorts caused by voltage surges in service. It tests each turn, coil, and phase group of the windings for adequate insulation strength to withstand the "steep front" high-voltage surges of actual service. First developed and applied by G.E., it's one of the production tests which all Tri-Clad motors must pass as they come off our production lines. – *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Each week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

"TUBE-UP" for full efficiency

Lummus heat exchangers — purchased for war emergency power plant and central station use during critical metal shortages — should now be reviewed for full heat transfer efficiency. In many instances tube bundles of substitute materials may now be replaced with bundles fabricated of metals that will increase operating performance. Furthermore, now is the opportune time to install additional heat exchangers which were necessarily omitted from plant design due to wartime restrictions.

Lummus engineering service is available for making such a review and for the study of specific metal replacement problems and the modernization of power plants to meet post war requirements. For further information write to:

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SURFACE CONDENSERS
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- OPERATES a chain of waterfront terminals from the Gulf of Mexico to New England.
- DISTRIBUTES petroleum products through 2000 wholesale bulk plants which also service a network of many thousands of Sinclair Dealer stations.
- PRODUCES basic material for manufacture of synthetic rubber in one of the largest butadiene plants in the United States.

Sinclair is America's outstanding manufacturer of lubricants.

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Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 2

"Phosphorized Admiralty"—and its dezincification-resistance

The qualities of this condenser tube material as confirmed in actual performance and reported by Scovill engineers

Millions of pounds of Phosphorized Admiralty are now in use in heat exchanger and condenser service — some since 1939 when this Scovill material was first introduced. Phosphorized Admiralty has built up a remarkable performance record and its resistance to dezincification is of a high order.

An explanation of this may be of interest.

The *dezincification-resistance* of Phosphorous bearing brasses is well known.

The *marked influence* of a very small percentage of Phosphorous in controlling this form of corrosion of Brass has been the subject of considerable research. In this connection, much interest has been shown not only in the actual ability of Phosphorized Admiralty and other phosphorized brasses to inhibit dezincification but in the reasons for the beneficial effect imparted to such alloys by Phosphorous.

Several theories have been advanced and much investigational work has been carried out to explain the inhibiting action of Phosphorous in brasses under service conditions which would normally result in dezincification of the metal. This problem will be better understood by a consideration of the properties of Phosphorous and its compounds.

Phosphorous is non-metallic in character and enters into combination with Oxygen to form a series of oxides. From Phosphorous and its various oxides, a number of metal salts may be obtained. With the exception of Sodium and Potassium salts, these metal compounds are, in general, insoluble in water. In some cases, these salts exhibit colloidal properties to some degree. The end product of the oxidation of Phosphorous gives ortho-phosphates and, in the presence of sufficient Oxygen, ortho-phosphates will be found.

One interesting detail in connection with the compounds of Phosphorous is the behavior of Tin and Phosphorous when they are present in the same solution. Tin Oxide in colloidal solution readily takes up or absorbs Phosphates and this reaction usually hastens the precipitation of Tin in a very insoluble form. It was earlier believed that this reaction was entirely of a colloidal nature, but, recently, it has been shown that a definite compound of Tin Phosphate is formed, at least in certain conditions. This particular reaction between Tin and Phosphorous compounds is stressed because it has been noted in a research on the dezincification of brasses that the presence of Tin in itself retards dezincification to some extent; but the addition of Phosphorous (as in Phosphorized Admiralty metal) is necessary to prevent dezincification of the alloy.

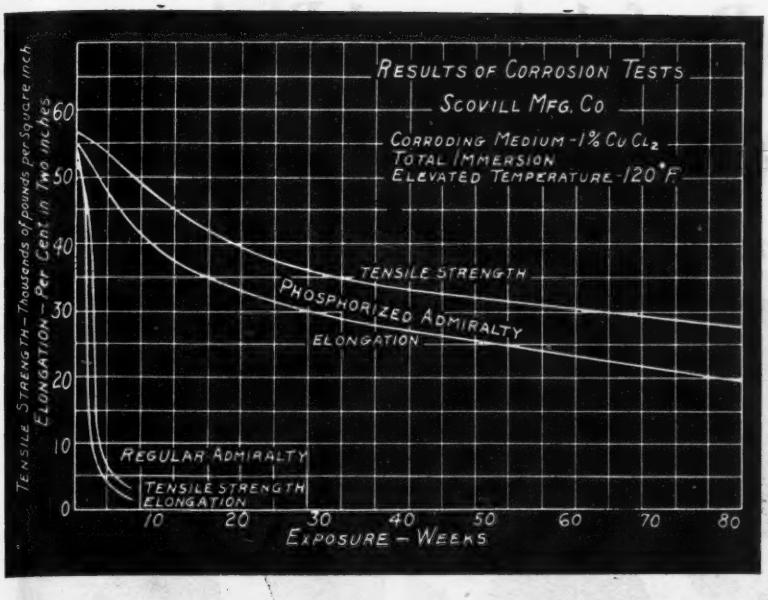
If the foregoing discussion of the formation of insoluble and colloidal metal salts of Phosphorous is remembered, the dezincification-resistant property imparted to Brass by the addition of Phosphorous can more readily be explained. In services where dezincification of Admiralty metal or other brasses has been experienced, the phosphorous content of the dezincification-resistant alloys probably promotes the formation of a protective film (in the nature of a metal phosphate or phosphide such as Copper Phosphide Cu_3P_2), which coats the metal surface at initially corroded areas and arrests further action at such areas.

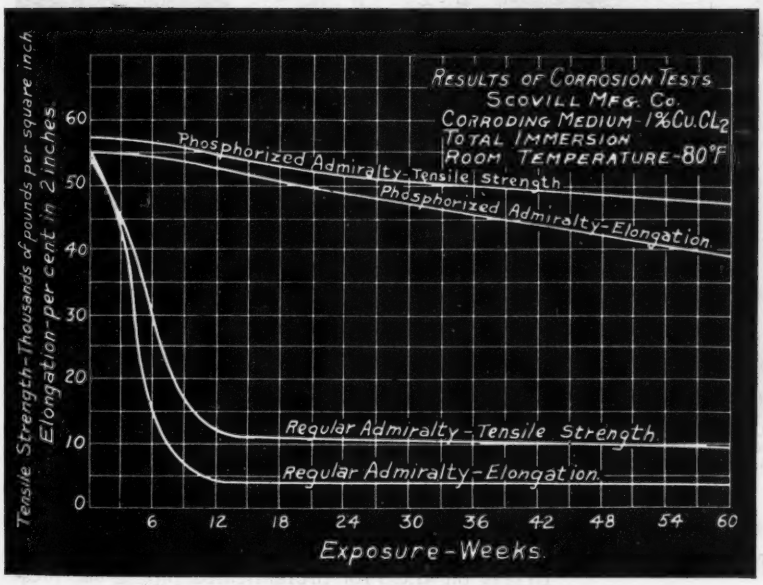
The reactions which take place in the formation of the phosphorous containing film may or may not be complex in nature, as may be anticipated from the above remarks on the chemical reactions of Phosphorous. Thus, in the early stages of corrosion, Phosphorous, together with Copper, Zinc and Tin may pass into solution and the Phosphorous may then combine with certain of the metal ions in solution to form an insoluble compound which coats the metal surface as a stable impervious film. The formation of this compound may involve nothing more than introduction of ions of the reacting elements into the solution, followed by precipitation and deposition of certain combinations of such ions on the metal surface.

It is probable, however, that a more complex series of reactions takes place and may be better explained by considering the existence of colloids in the medium in contact with the metal surface. In this connection, it may be pointed out that very minute quantities of colloids in a solution often times produce a profound change in the behavior of such solutions. In the plating of metals, for example, colloids in the plating bath may alter the type of plate, may prevent plating altogether, or may change the conditions (current density, voltage, etc.) at which satisfactory plating may be carried out. The subject of plating is introduced in this discussion of colloids because dezincification may be looked upon as a plating operation in which Copper is plated upon the brass, usually in the form of a porous, brittle mass. In the case of Phosphorized Admiralty tubes, colloidal Tin Phosphate or other metal phosphates may play an important part in preventing dezincification of the alloy.

This discussion of the part which Phosphorous plays in preventing dezincification of Admiralty metal and other Brasses has necessarily been brief and has been presented only because of the interest which has been shown in this subject.

Wherever dezincification of Admiralty metal tubes has been a serious corrosion problem, the use of Phosphorized Admiralty metal tubes is suggested. This alloy combines the general excellent corrosion-resistant properties of Admiralty metal, a desirable fine grain structure of




RESULTS OF CORROSION TESTS
SCOVILL MFG. CO.
CORRODING MEDIUM - 1% Cu Cl2
TOTAL IMMERSION
ROOM TEMPERATURE - 80°F
Phosphorized Admiralty - Tensile Strength
Phosphorized Admiralty - Elongation
Regular Admiralty - Tensile Strength
Regular Admiralty - Elongation
Tensile Strength - Thousands of pounds per square inch.
Elongation - per cent in 2 inches
Exposure - Weeks

developed primarily for oil refineries and gasoline plants because in those places the phenomenon of dezincification is pronounced and widespread, it is equally applicable to any situation where dezincification of Admiralty is a problem — particularly at elevated temperatures.

"Phosphorized Admiralty tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by the owner of this Scovill Manufacturing Company patent, or one of its licensees.

Scovill Offers 3 Services to Tube Users

1. Information, like that appearing on these pages, which will help keep engineers informed of recent developments and recent thinking in the matter of condenser tubes. The new "Condenser Tube Booklet" — a part of Scovill's *Service in Manuals* is available, free, from Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Connecticut.

2. Research in Metals is another Scovill service, intended to establish new knowledge about metal alloys which will help develop better performance on the part of Scovill condenser tubes. Scovill *Service in Metals* also includes the testing of raw materials, the testing of finished tubes before shipment and the analysis of problems arising from tubes in service.

3. Individual recommendations for each customer's requirements constitute the third Scovill service. *Service in Men* brings you a wealth of experience to help you obtain the best results and to eliminate trouble causes.

the finished tubes, favorable physical properties and a very definite improvement over Admiralty metal in its very marked resistance to dezincification.

While Phosphorized Admiralty was

Limitation order L-154 issued by the OPM, limits the use of nonferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No nonferrous metals containing more copper and more tin than these two are permitted by the order.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

If you use Prefabricated Piping, Pressure Vessels and Heat Exchangers

ALCO "Triple Service" can save you Time and Money

WHEN you buy prefabricated piping, pressure vessels, and heat exchangers from ALCO, you save time and money. Here's why:

1. PURCHASING WILL COST YOU LESS

If you buy these products from separate sources, your purchasing department will be compelled to deal with at least three companies; negotiations will be needlessly complicated, consume more time, cost you more money. But by letting ALCO supply your requirements for all of these products, you simplify purchasing, save time and expense.

2. ENGINEERING WILL COST YOU LESS

When you purchase prefabricated piping, pressure vessels, and heat exchangers from three or more different sources, your engineers are compelled to deal with each of the various engineering departments of all these suppliers. That means more time and money loss to your organization. This waste, too, can be saved when you deal with ALCO on all these counts.

3. INSPECTION WILL COST YOU LESS

If you buy prefabricated piping from one source, and pressure vessels and heat exchangers from others, you must send three inspectors to the three plants fabricating your equipment. ALCO "triple service" means all inspection can be handled by one inspector at our Dunkirk plant.

4. ACCOUNTING WILL COST YOU LESS

Finally, your accounting department has three separate accounts to handle—instead of one—if you deal with three suppliers of prefabricated piping, pressure vessels and heat exchangers, respectively; instead of leaving it all to ALCO.

• • •

ALCO's reputation for competence in designing, fabricating and delivering on time is beyond question. To rely on ALCO for prefabricated piping *and* pressure vessels *and* heat exchangers is good business for your company and will be thoroughly justified by *results*. We welcome the opportunity of demonstrating the advantages you gain by ALCO "triple service."

American Locomotive

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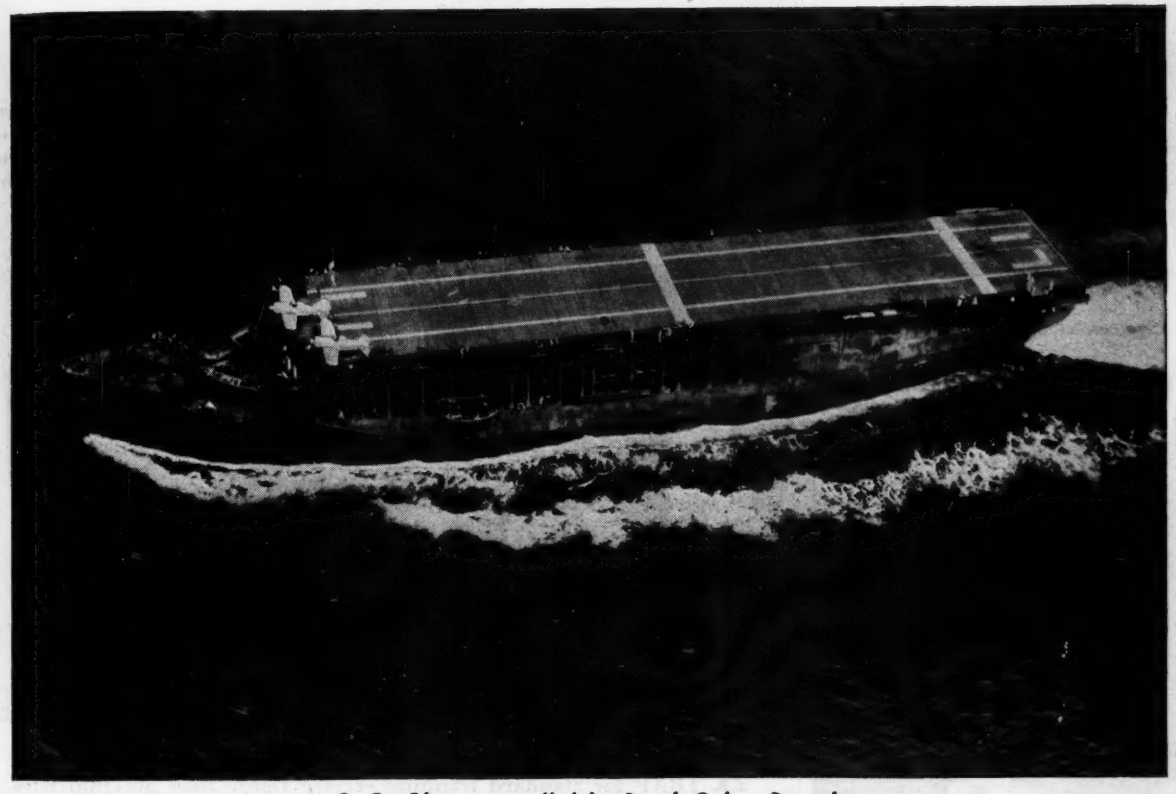
30 Church Street, New York 8, N. Y. • Dunkirk, N. Y.

First Baby Flat-Top Hangs Up a Great War Record



P. S. She is propelled by Busch-Sulzer Diesels

The Navy Department recently revealed that America's first escort aircraft carrier, the U. S. S. Long Island, had a part in the history-making victory at Midway. Its 'planes covered the operations of certain warships that turned back the Jap fleet bound for Hawaii.

The Long Island's appearance in the Pacific came after her pioneer work fighting U-boats. Her first air squadron, "composite one", recently was disbanded after receiving a presidential unit citation for having sunk, probably sunk or seriously damaged more enemy submarines than any other team in naval history, up to November 10, 1943.

With the easing of war demands, Busch-Sulzer will be able to step up rapidly its delivery of engines to peacetime customers without reconversion. Now is the time to decide what you need and assure yourself of early delivery. Please write us concerning your requirements.

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AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

Yarway Impulse Traps

For Pressures Up to 1500 lbs

Fig. No. 140 to 147. Medium pressure Integral-strainer Impulse Trap for pressures up to 600 lb. Steel body, flanged connections.

Fig. No. 250 to 257. Medium pressure Integral-strainer Impulse Trap for pressures up to 600 lb. Steel body, socket weld connections.

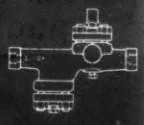


Fig. No. 410 to 417. Low pressure Integral-strainer Impulse Trap for pressures up to 150 lb. Bronze body, screwed connections.

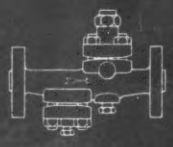
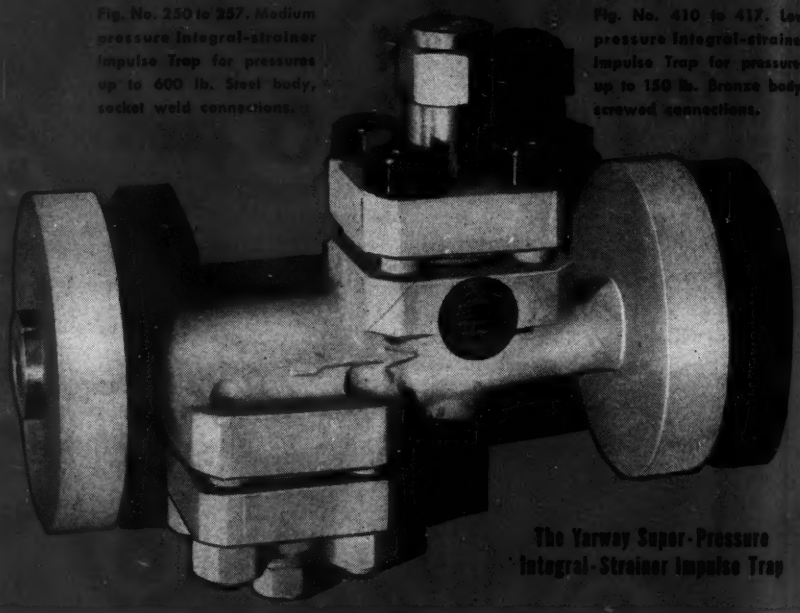
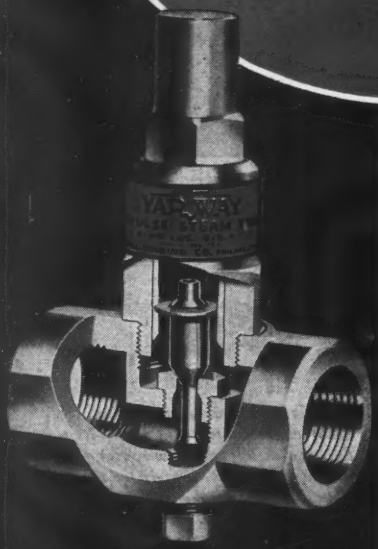


Fig. No. 150 to 157. Super-pressure Integral-strainer Impulse Trap for pressures up to 1500 lb. Steel body, flanged connections.



The Yarway Super-Pressure Integral-Strainer Impulse Trap



The Standard Yarway Impulse Trap. Note only one moving part — a little valve.

ALONG with the remarkable success of the YARWAY IMPULSE TRAP for standard trapping service (more than 300,000 have been purchased), has come its use in steam plants where pressures as high as 1500 lbs and temperatures as great as 900°F are encountered.

The integral-strainer trap shown above, developed for this service is suitable for every drainage requirement in high pressure steam installations. It has ample condensate capacity when system is being "warmed up". It will handle relatively small amounts of high temperature condensate, efficiently, without losing its prime.

The valve closes positively in the presence of dry or superheated steam.

It is a fraction of the size and weight of other type traps designed for the same service—saving space, simplifying installation and requiring no support.

It is suitable for all pressures within a wide range without change of valve or seat.

It has the same simplicity of design as does the standard Impulse Trap—only one moving part, a little valve.

Its integral-strainer protects the trap against scale and rust in the system.

For complete description of operating principle, send for Bulletin T-1738.

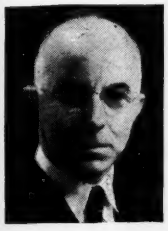
YARNALL-WARING COMPANY, 114 MERMAID AVE., PHILADELPHIA 18, PA.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

What Are We Going to Do About Human Wants?

By ROY C. MUIR



THE basis of any economic policy is the satisfaction of human wants. Throughout history the struggle of man has been to attain "Freedom from want of the essentials of life—food, clothing, and shelter." Technology has shown us the means to attain that freedom for all men and has further opened the path which leads to the satisfaction of wants in the luxury classification, or a more abundant life.

The degree to which these further wants, which are unending, may be satisfied for the whole people is proportional to increase of real wages. Real wages must increase, real wages can increase—through placing more power at the disposal of each workman, through improved machines, improved methods, new materials, and more efficient production and distribution of electric power.

Probably the most apparent of all human wants is good housing. In this country, we want new homes—1,000,000 or more per year for many years is a very conservative estimate. There may be an increasing trend to prefabrication, but whether prefabricated or built on the ground, each home will want electric service: a central heating plant, an electric refrigerator, washing machine, ironer, range, vacuum cleaner, toaster, clocks, electric lighting, and other electric appliances. An increasing number will want the electric dishwasher, electric garbage disposal system, electric water heater, and electric blankets. All will want radio, and an increasing number will want television.

The most promising development on the food front is frozen foods, and the various means for home freezing and storage. Many look upon the frozen food cabinet as the second refrigerator in the home. Others believe that the household refrigerator will take on frozen food storage as an added compartment. Whatever form the frozen food cabinet takes, frozen foods will make a substantial contribution to better nutrition and better living for millions of people.

The satisfaction of one want leads to a new want.

Only 12 per cent of American families are now enjoying the low cost luxury of electric cookery, but over half prefer electricity.

The warmth and lightness of an automatic electric blanket are unknown to 99 per cent of the people.

Perhaps the most significant lighting development of recent years has been that of the fluorescnt lamp, which is no longer new, but whose major contribution to human wants yet remains to be realized. The announcement of the circular fluorescent lamps as well as the so-called "long-slim" lamps, which must await peacetime before their final development, will likewise further the coordination of lighting and architecture.

Those who view the future of lamps and lighting with only ordinary optimism foresee an electrical requirement nearly equal, if not entirely beyond the total electrical demand up to the beginning of the war.

Much has been said about rural electrification, and over 40 per cent of the farmers (2,600,000) in this country are using power line electric service. Another 2,000,000 want this service and our problem is to create wants to build up each individual farmer's load to a point where he can be economically served. This seems to be feasible. We should look upon each farm as: first, a residence; and secondly, a small industrial customer who produces food.

I would prefer to look upon electronics as a new tool—something plus, or in addition to that we now have, rather than something that will outmode the brilliant inventions of the past or completely change our way of life.

The placing of more electrical energy at the disposal of each workman is a matter of working out ingenious controls, and machines, and electrical processes to do things that were impossible with earlier equipment.

Electronics has entered our industrial life as a full-fledged partner; as a new tool. Resistance welding, electronically controlled, has revolutionized numerous manufacturing processes. Electronic control of motors and of circuits generally has opened up new fields for better utilization of electric power.

High frequency heat is still in its infancy, but its extensive applications, such as surface hardening of metal parts and uniform and fast heating of dielectric materials open a large vista of new uses of electric power.

And what about the wants of the electric power industry itself? It is tactically located in the key position; upon it practically all of our other activities depend.

Thus far efficiency and operational reliability have meant so much in operating costs that these have had the preference over low first costs. The industry is giving some encouragement to a standardization of ratings which should enable the maufacturers to obtain lower costs through duplication of production. Emphasis on factory assembled "package" products is also a step in the right direction. There is no thought in these moves to freeze techincal design, rather it gives equipment manufacturers more opportunity to concentrate on the research and development program necessary to achieve better performance at lower costs.

The step from a 10,000 Btu station to a 9,000 Btu station is a big one. Higher steam temperatures, reheat, and refinement in boiler and auxiliary design offer possibility of some improvement in the economy of the large coal burning steam station. 9,000 Btu is within the reach of the mercury steam cycle. The problem here is one of obtaining lower first costs, and we hope with experience this can be done. New cycles may develop in the future.

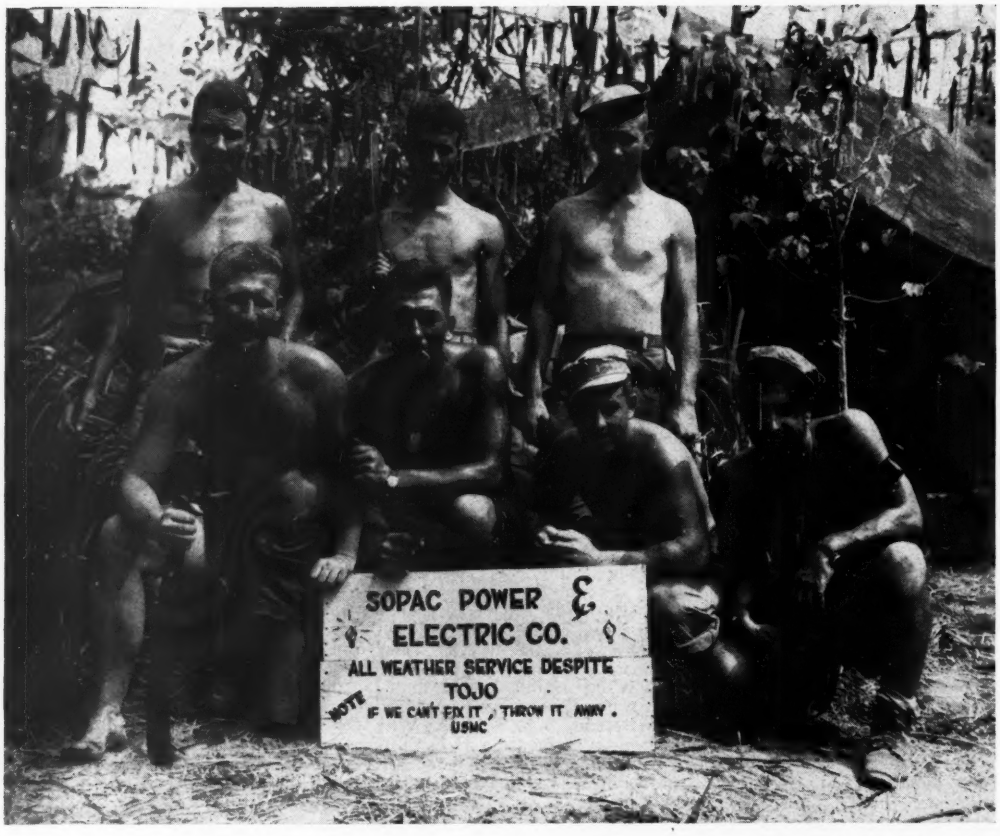
When these developments of the simple gas turbine have been mastered we shall be better qualified to judge the possibility of its future development as a legitimate competitor of the larger and more efficient power generating plants.

Research and engineering for the electric power industry is not losing impetus—there are still too many wants to be satisfied and too many encouraging factors in sight to permit of any slowing down.

ROY C. MUIR, General Electric Co. vice-president in charge of Engineering since 1934, was born in Arcadia, Wis., in 1881. Mr. Muir entered the University of Wisconsin in 1901 and received his B.S. in electrical engineering in 1905. After graduation he entered the G.E. student engineering course at Schenectady where he was 2 yr on test. In his second year, he was made assistant to the head of Turbine Test. In 1907 he was transferred to the Turbine Engineering Department, and in the following year, to the Power and Mining Engineering Department, now the Industrial Department.

When the International General Electric Co. was organized in 1919, Mr. Muir was appointed chief commercial engineer of that company. In 1922 he was made assistant engineer of the Industrial Engineering Department. In May, 1930, he became general assistant to the late Charles E. Eveleth, then vice-president in charge of engineering, in 1933 was appointed manager of the Engineering Department, a position he held until his promotion the following year to vice-president in charge of Engineering.

The material presented on this page is from a recent address before the annual EEI meeting, New York, June, 1944.



Official U. S. Marine Corps Photo

Power Makers in Bougainville

This has been called an engineers' war because every type of scientific knowledge is being applied to the problems confronting the combatants. If anybody doubts that statement let him take a look at this picture taken in the jungles of the South Seas. Seven American Marines who might well qualify for places on a champion football team are shown in scientifically camouflaged quarters, equipped with scientifically made weapons, the one throw-back being the bolo knife (or are those corn knives in the hands of the Kansas and Pennsylvania boys). Certainly the rifle, the pistol and the Rising gun are engineering masterpieces. The clothing, perhaps attire would be the better word considering the growth of beards on several of these huskies, is that scientifically developed by jungle natives as best suited to the climate. A difference of opinion, however, seems to exist regarding the foot wear. Oh yes, there's the jewelry—dog tags, rings and watches—all scientific? You answer that one. All honor, however, to this group of stalwart young American Marines who handle the power equipment for a Marine unit in the Bougainville offensive. They made the landing with the advanced troops and are veterans of numerous Jap air raids and artillery shells. Here are their names, left to right front row: Private First Class W. G. Neal, 119 S. Alexandria St., Hoisington, Kan.; Technical Sergeant Paul Jeffries, 2912 Montebello Terrace, Baltimore, Md., in charge of the power plant; Private Donald E. Lambertson, Homasassa, Fla.; and Private First Class Normal H. Carl, Reinerton, Pa. Rear row, left to right, Private First Class Roger J. Emmert, 341 Brown Street, Grand Rapids, Mich.; (Emmert formerly worked for the telephone company in Grand Rapids. His wife lives at 206 N. Mayo Avenue, Compton, Calif.); Corporal Frederick A. Marcello, 329 W. 17th Street, Erie, Pa., and Private Patrick O. Finnigan, RR No. 1, Allen, Texas.

WITH THE EDITORS

◆ **End in Sight**—The overwhelming Allied victories of recent weeks leave little doubt that the end of the European war is in sight. The German armies are shattered and from here on, it is largely a matter of cleaning up, of getting the thing over. Only the desperate hope of the Nazi leaders to secure an easy peace makes them continue the struggle. While it is possible that there will be no formal surrender and that the disintegrated Nazi forces will continue to snipe at U. S. and British armies even after we occupy Germany, the big job will be over and we can begin to think about conversion to a peacetime economy. This does not imply sudden stoppage of the war effort on the manufacturing front. Many military items are still needed, but from now until the war's end the country will be waiting, and in the meantime making what preparations and adjustments it can without relaxing in the work and effort still needed.

◆ **Reconversion**—Reconversion in its present-day sense is a complex term and means many things to many people. Specifically, of course, it means the retooling and the reorganization of manufacturing plants so that such plants can begin to make civilian goods, but in its broad sense it means everything from the removal of priorities and buying restrictions to running our cars again at 60 mph. The military viewpoint is that too much emphasis is being placed too early upon reconversion and that the war effort is being hampered by failure to concentrate sufficiently upon the production of military items that are still urgently needed. On the other hand, a strong body of opinion holds that post-war programs are subject to far too much delay and controversy, and that the country will pay the penalty in the form of depression and unemployment for not being farsighted.

It is possible that the situation is not as bad in either respects as the extreme critics charge and that it will be brought into better shape, before time runs out, than they are now ready to believe. Certain war items, according to testimony by military officials, are behind schedule and below needs but these are the exceptions and in the case of the overwhelming majority of war items, production is up to requirements and the stocks abundant. Certain government surplus property is already being offered for sale and we can expect a great deal more to come on the market in the very near future.

It would appear reasonable, therefore, for those with conversion or rehabilitation problems to begin doing what they can about them now. Government post-war planning may be slow but that does not prevent any individual or private organization from doing its own planning, and in this respect, the safest bet seems to be to count on an early end to the war in Europe. WPB announced recently, that immediately after X-Day, almost all controls will be lifted—no more priorities, no more forms to file, no more production schedules. Of course, *immediately* does not necessarily mean the next day or the next week, but it can't be long.

◆ **Rehabilitation** — Rehabilitation of the injured veteran is a problem that should be included in every reconversion plan, yet among the numerous plans for the post-war activity that have been formulated very few have even mentioned this phase of the problem. It is high time that plans be made to care for the unfortunate living victims of the war as they come back into civilian life under handicaps that may require an entire readjustment of education and training.

Each individual is a special case and although attempts are made to classify physical defects, complications arise which compel separate consideration of each employe. A plan of procedure suggested by the American Mutual Alliance consists of the following five steps: 1, Learn the medical facts. 2, Analyze your jobs. 3, Match the man and the job. 4, Introduce the man to the job. 5, Plan for follow-up.

This plan has been used successfully by insurance companies in the rehabilitation of workmen who have been injured in industrial and other civilian accidents and could readily be made the procedure in rehabilitating injured veterans.

To determine the medical facts, each individual would of necessity have to submit to an examination by a competent physician, for the applicant may have other afflictions than the injuries received in the service. The second step, analyzing the job, can best be done by the men in the plant who designate and supervise the tasks to be performed.

Matching the man to the job is a problem for the physician, the supervisor and the disabled employe, all three working co-operatively to find a job satisfactory to the employe that will not impair his health but will enable him to perform a service profitable to the employer.

Introducing the man to the job is another term for teaching or training him to perform the work for which he has been hired in the safest and most efficient manner. Probably most of the handicapped men will consider first the work for which they were trained before they were called into service. Those definitely unfitted for their former jobs may seek work as a foreman or manager wherein their former experience will be an asset and their physical defects will not impair the efficiency of their services.

Others seeking work may have had no experience, except schooling, prior to service in the war and these must be given a complete course of instruction in the work they are selected to perform. In all cases of introducing a handicapped man to the job, complete success is obtainable only when the instructor employs psychological principles designed to develop in the employe self-confidence and a sense of the importance of his job.

The task of following-up on the progress of a handicapped man needs to be done by a physician in collaboration with the man who directs the work of the employe. Here again the use of psychology can do much to aid the progress of the individual. He will need encouragement and direction all along the road to the point where he is self-reliant, capable and efficient in his work.

Employers have found through experience that rehabilitated workmen who have been thoroughly trained are efficient, careful, industrious, loyal and seldom absent from their work. Some employers, however, refrain from hiring men who have handicaps on the assumption that companies writing workmen's compensation insurance increase the premium rates when physically handicapped persons are employed. We have been assured that that is not the case as serious second injuries to previously injured workers occur infrequently. This whole question is being studied by various state legislatures with a view toward passing laws favorable to the handicapped veteran.

A detailed discussion, by men with experience, of the problem of rehabilitating handicapped veterans for work in power plants would be welcomed by the Editors of POWER PLANT ENGINEERING. We would like to hear from those who have plans in operation, those who are making plans, and those with personal handicaps who can relate experiences that might be helpful to others.

◆ **The Heat Pump**—It is very encouraging to note the recent renewal of interest by engineers in this country in the "heat pump". Some time ago, in an excellent paper presented before the Edison Electric Institute, Phillip Sporn of the American Gas & Electric Co., outlined the advantages of this method of heating or cooling, and more recently, R. U. Berry of the Air Conditioning and Commercial Refrigeration Division of the General Electric Co. discussed it before the Summer Technical Meeting of The American Institute of Electrical Engineers.

Heat pumps are refrigerating systems in which the principal interest is in the heat given off by the condenser. A portion of this comes from the electrical input to the compressor and the remainder from cooling an external source of heat, usually outdoor air. The heat output is several times the equivalent of the electrical input and these systems offer possibilities of fuel economy beyond anything possible with fuel-burning equipment.

The idea of the heat pump is not new since Lord Kelvin called attention to the principle over ninety years ago but it becomes of practical interest today because of the recent advances in the use and development of air conditioning equipment. As air conditioning gains greater acceptance we can expect interest in the heat pump idea to grow and it is quite possible that we will see a great deal of practical development of such systems in the next ten years. A few actual installations were made before the war and nearly all of them are in successful operation today. As pointed out by Mr. Berry, the heat pump idea has not received the promotion that manufacturers and utilities gave to the household electric refrigerator when it was introduced but endeavors certainly will be made to promote it in the post-war period. The future development of the heat pump for residential use will probably depend upon the relative success or failure of these endeavors.

Outdoor Equipment Features Harvey Couch Station

New 30,000 kw steam electric generating plant of the Arkansas Power and Light Co. has most of the major equipment installed outdoors. Only the boiler feed pumps, turbine auxiliaries, heat exchangers, evaporators and electrical switchgear are installed indoors. The turbo-generator, though protected by a metal housing is completely outside the building proper. The outdoor boiler is designed to burn either gas or oil but at the present time only natural gas piped from the McKamie oil field is burned

AMONG the comparatively few new steam-electric generating stations that have been built since Pearl Harbor, one that deserves special mention because of unusual features, is the Harvey Couch Station of the Arkansas Power & Light Co. The initial installation which has now been in operation nearly a year consists of one 30,000 kw turbogenerator, an outdoor 350,000 lb per hr boiler and all necessary auxiliaries to make a complete steam-electric generating plant.

The general design was governed largely by the necessity of conserving materials vital to the war effort and to that end the station building itself is unusually small. Though originally designed with a steel frame, this was changed to reinforced concrete, using steel platforms in cases where the greater bulk of concrete would have made its use prohibitive, or where it was necessary to have platforms removable.

To the end of having as small a building as possible, a large part of the equipment is placed outside. The top of the thirty-one foot high turbogenerator foundation is flush with the roof line so that this machine is completely outside the building and is protected by a removable metal housing. It is served for maintenance and overhaul by a traveling gantry crane which runs the length of the roof. This crane serves auxiliaries in the building through removable roof hatches. On the highest roof of the station building and in the open is located the feedwater deaerating equipment and storage tank. Removed from the station building is the large water pump that circulates condensing water through the condenser from the cooling tower, and all transformers that feed the electrically driven plant auxiliaries.

The electric generating unit consists of a 25,000 kw, 0.8 power factor, 13,800-v, 3600-rpm, hydrogen-cooled General Electric turbogenerator designed for steam at 650 psi and 825 F at the throttle, together with direct-connected main and pilot exciters. In the installation of this generating unit conservation of materials was effected by the omission until a later date of a spare oil cooler.

The steam generating unit is a Combustion Engineering 3-drum, bent-tube, gas-fired boiler, complete with water walls, superheater, air heater and fan equipment. The boiler proper contains 14,350 sq ft of heating surface. The unit has a capacity of 350,000 lb of steam per hr at 710 psi and 830 F. As already pointed out, the boiler is of weatherproof construction and is erected outdoors with an enclosed firing bay, facing and built integrally with the station building. The unit is designed to burn either gas or oil though at present only gas is burned. Tanks and other auxiliaries for oil burning will be added at a later date when materials become more plentiful.

The forced- and induced-draft fans, air heater and stack are located adjacent to the boiler on separate foundations. The forced-draft fan is an American Blower Co., high-speed, double-inlet, double-width fan rated at 113,400 cfm and is driven by a 300-hp Westinghouse squirrel-cage motor. The induced-draft fan is an American Blower Co. Sirocco unit, rated at 210,000 cfm and driven by a 700-hp Westinghouse squirrel-cage motor.

The gas used at the present time is piped from the nearby McKamie oil field. This is known as "sour" gas, high in hydrogen sulfide and is sweetened in a gas-treating plant under independent management. A standby gas line is tied in to an existing transmission pipe line in the vicinity. The boiler is fitted with six Peabody combination natural gas and oil burners.

Water for the entire plant is supplied by three deep-well pumps located on widely divergent spots on the property. These pump into a settling basin which serves as a foundation for a 50,000-gal elevated storage tank.

A sixteen-cell forced-draft cooling tower on the west end of the plant site, connected to the condensing equipment by twin reinforced-concrete ducts, cools the condensing water. Circulation in this cooling system is maintained by a 76-cfs Allis-Chalmers single-stage pump, driven by a 700-hp motor, located outdoors adjacent to the building. The cooling tower is provided with 16 plastic-blade fans direct-connected to 25-hp motors. At the rated capacity of 76 cfs this cooling tower cools the water from 105 F to 90 F with an ambient wet-bulb temperature of 76 F.

Boiler make-up water is softened by an Elgin zeolite down-flow pressure-type double unit softener, manually operated and having a rated capacity of 12,000 lb per hr. The condensing water is chlorinated but otherwise not treated.

The main boiler plant and turbine plant auxiliaries, two boiler feed pumps, transfer pumps, heat exchangers, turbogenerator lubricating oil system, evaporator, electrical load centers and switchgear are very compactly housed together with a complete piping system on the first and mezzanine floors of the approximately 90 ft sq by 31 ft high station building. The

Fig. 1. General view of Harvey Couch Station showing the cooling tower in the foreground

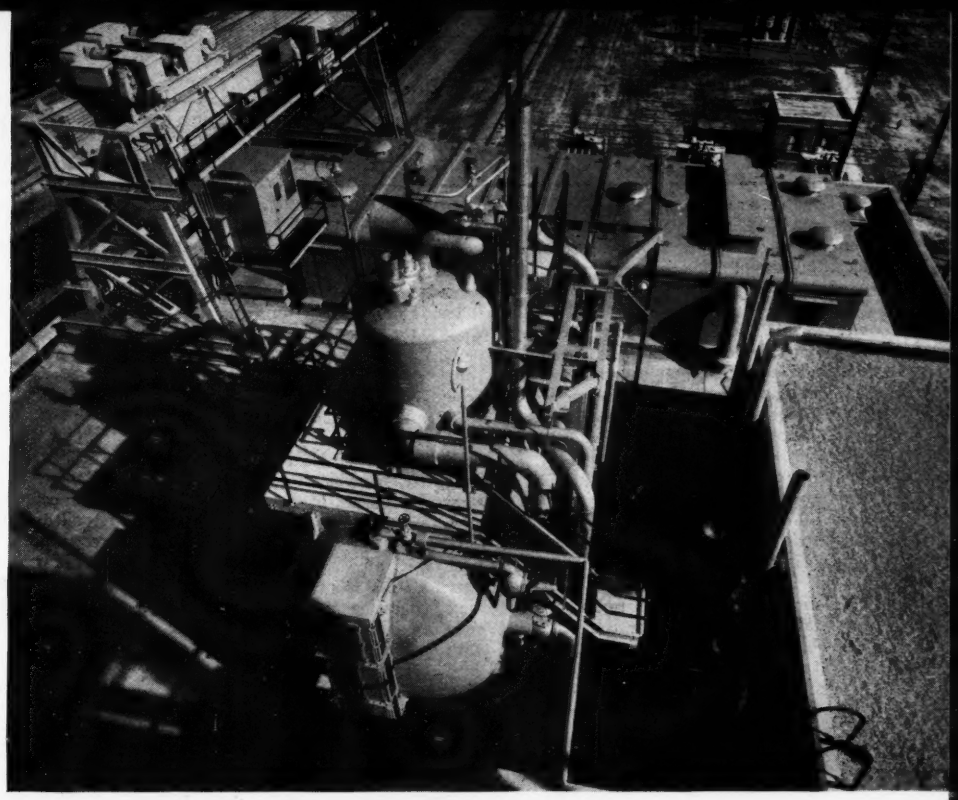


Fig. 2. View looking across the station building roof showing the deaerating feedwater heater in the foreground and the metal housing covering the turbogenerator just beyond. The metal covering over the turbogenerator is completely removable by means of the crane shown at the left

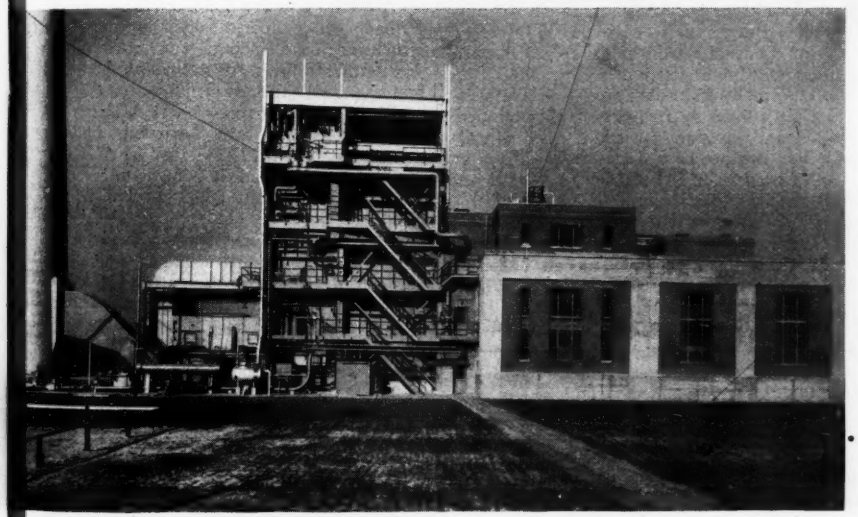


Fig. 3. General view looking north. This view shows the recently installed oil burner pump and the housing for the Zeolite water softeners. It also shows the location of the induced draft fan with respect to the breeching and the stack

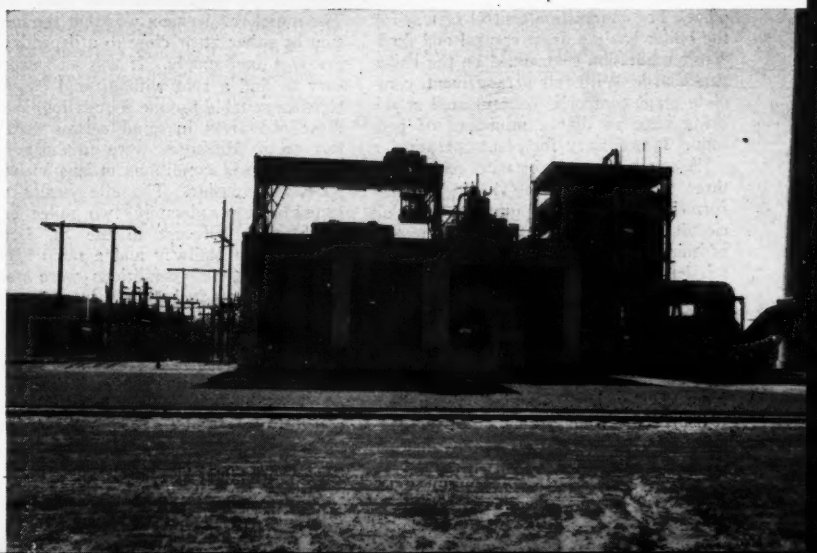


Fig. 4. A view of the station looking south. This shows the end of the removable metal turbogenerator housing on the roof just below the gantry crane. The deaerating boiler feedwater heater can be seen immediately to the right of the crane

LIST OF MAJOR EQUIPMENT ARKANSAS POWER & LIGHT CO. HARVEY COUCH (MC KAMIE) STEAM ELECTRIC STATION

TURBOGENERATOR—one General Electric, rated 31,250 kw 0.87 pf with hydrogen cooling at 15 psi, 13.8 kv 3600 rpm, including direct-connected main and pilot exciters

SURFACE CONDENSER—one Allis-Chalmers 2-pass non-divided water box type, 28,000 sq ft, rated 246 million Btu per hr, with auxiliaries

CIRCULATING-WATER PUMPS—one Allis-Chalmers horizontal single-stage, rated 76 cfs at 63 ft total dynamic head, with 700-hp squirrel-cage motor

CONDENSATE PUMPS—two Allis-Chalmers horizontal centrifugal, rated 290,000 lb per hr each at 300 ft total dynamic head, with 100-hp squirrel-cage motors

COOLING TOWER—one Foster Wheeler 16-cell forced-draft type, with plastic-blade fans direct connected to 25-hp motors, rated 76 cfs of water cooled from 105 F to 90 F with ambient wet bulb 76 F

STEAM GENERATING UNIT — one Combustion Engineering bent-tube type for 710 psi gage 830 F, rated 350,000 lb per hr continuous, comprising:

	Heating Surface, Sq Ft
Boiler	14,350
Water walls	5,520
Superheater, Elesco with manual bypass damper	6,600
Air heater, Ljungstrom regenerative	43,000

BURNERS—six Peabody combination natural-gas and oil

FORCED-DRAFT FAN — one American Blower No. 9 American High-Speed, double width, double inlet, rated 113,400 cfm 11.45 in. static at 1180 rpm, with 300-hp squirrel-cage Westinghouse motor

INDUCED-DRAFT FAN — one American Blower Sirocco, rated 210,000 cfm 12.1 in. static at 700 rpm, with 700-hp squirrel-cage Westinghouse motor

RADIAL-BRICK CHIMNEY—one Alphons Custodis unlined, with manganese-shade perforated hard-burned; 150 ft high, 10 ft inside diameter at top, 16.5 ft at base

BOILER FEED PUMPS—two Allis-Chalmers type MD 5-stage double suction, rated 275,000 lb per hr normal (max design 380,000 lb per hr) at 300 F and 2370 ft total dynamic head; one 600-hp 3570-rpm squirrel-cage motor; one 700-hp motor to be replaced by, when available, Terry steam turbine type GS, 600 hp for steam 650 psi 825 F at throttle and 50 psi gage back pressure

DEAERATING HEATER—one Elliott vertical type, rated 300,000 lb per hr normal (max 400,000 lb per hr) for 50 psi gage max operating pressure, mounted on storage tank having 125,000 lb capacity, with auxiliaries

EVAPORATOR—one Foster Wheeler type HP single-effect, with internal preheater, rated 10,000 lb per hr at 46 psi abs, with 2-pass vent condenser and accessories

HIGH-PRESSURE HEATER — one Foster Wheeler 945-sq ft 2-pass U-bend vertical closed type for 9th stage, rated 24.5 million Btu per hr to heat 295,000 lb per hr of condensate from 273 F to 325 F when supplied with steam at 158 psi abs

LOW-PRESSURE HEATER—one Struthers-Wells 1230 sq ft 4-pass U-tube vertical closed type for 15th stage, rated 24 million Btu per hr to heat 215,000 lb per hr of condensate from 82.5 F to 194 F when supplied with steam at 11.3 psi abs

WATER-SOFTENING PLANT—one Elgin zeolite down-flow pressure type double-unit manually operated, rated 12,000 lb per hr, with accessories

FUEL OIL HEATER—one Lummus horizontal type, 915 sq ft rated 2,150,000 Btu per hr to heat 27,000 lb per hr of bunker C oil from 70 F to 250 F when supplied with saturated steam at 100 psi gage

LUBRICATING OIL purification system—one Bowser No. 7-E type A continuous filtering, rated 500 gph, with 2-compartment 5000-gal precipitation tank, also transfer oil pumps and accessories

AIR COMPRESSOR—one Gardner 6-cylinder 2-stage, rated 316 cfm at 100 psi, with air receiver and 75-hp squirrel-cage motor

SERVICE-WATER PUMPS—two Ingersoll-Rand No. 5-UV single-stage double-suction centrifugal, rated 1000 gpm at 300 ft total dynamic head, with 100-hp squirrel-cage motor

MAIN CONTROL SWITCHBOARD — one Westinghouse duplex type complete with meters, relays and accessories, mounted in enclosed cubicles and on swinging rear panel

AUXILIARY POWER SWITCHGEAR — one General Electric 2300-v indoor type metal clad, comprising floor-mounted structure of 14 cubicles, each with electrically operated removable-type air circuit breakers, rated 5 kv and 100,000-kva interrupted capacity, with accessories

AUXILIARY POWER LOAD CENTERS—two Pelham 440-v floor-mounted metalclad structures (one indoor, one outdoor) from transformers to station auxiliary motors

MAIN TRANSFORMERS—three Moloney 10,000-kva single-phase 2-winding outdoor type, rated 13,333 kva FAOC, 66.4/115-kv wye and 13.2-kv delta with taps for 112.5/110/107.5/105 kv, with accessories

AUXILIARY POWER TRANSFORMERS — two Wagner 2-winding 3000-kva 3-phase self-cooled outdoor type, rated 13.8-kv delta and 2.4-kv delta with taps for 13.455/13.110/12.765/12.4 kv.

first floor is at ground level since outdoor location of many auxiliaries obviates necessity of a deep basement.

A pent-house on the station building roof adjacent to the firing bay, houses the boiler and turbine gageboards, the generator hydrogen control panel, generator pilot board and the superintendent's office. The combustion control system for the boiler has the draft control and feedwater regulation centralized on the boiler gageboard. With this arrangement, complete plant control is concentrated at the firing aisle so that a minimum of personnel is necessary for plant operation.

A small step-up substation comprising three 10,000-kva, 13,200/110,000-v transformers and a three-pole 110,000-v oil circuit breaker is located just to the east of the station building to feed a transmission line to McKnight Substation, 15 miles away, where ties are made to the company's transmission system. A spare transformer may be added at a later date.

The main plant auxiliaries are fed from 2300-v bus, supplied, through a 13,800/2300-v transformer, from the generator main leads. Smaller motors and lights are supplied from 2300-v bus through additional step-down transformers. During plant outage periods, auxiliary supply is from 110-kv transmission line, through main transformers.

Two main considerations were kept in mind in the selection of the plant site. The initial requirement was that the location be either at or close to a dependable low-cost fuel supply. It was also necessary to find a spot with ground characteristics suitable for the foundation. With these objectives in mind certain localities about McKamie were first investigated but soil conditions in this vicinity were unfavorable. The site finally selected is approximately two miles east of Stamps, adjacent to the St. Louis Southeastern Railway and a main highway. There, soil conditions were good and source of fuel supply was not far distant, McKamie being about ten miles to the south.

Investigations for site were started early in March of 1942, and the work of clearing and grading, installation of railroad spur and an access road, was started at the site selected, about June 1 of the same year. As soon as this work was completed, about the latter part of August, a contract was let for the construction of all concrete foundations and the main building superstructure. Most of the foundations were in by the early part of 1943 and the main building superstructure was completed around July.

The plant was designed by Ebasco Services Incorporated, with field supervision by Mr. W. M. Wolford as superintendent of construction, and Mr. A. A. Edewaard as resident engineer. J. P. McNulty had the general contract for concrete work. R. H. Bouligny, Inc., of Charlotte, N. C., received the contract for all electrical work. Contracts for the installation of the various major mechanical units were as follows: Turbogenerator by General Electric Co., boiler by Combustion Engineering Co., Inc., condensing plant by Allis-Chalmers Mfg. Co., cooling tower by Foster Wheeler Corp., and piping by Blaw-Knox Construction Co. Other smaller units were installed by Arkansas Power & Light Company's own forces.

A New Three-Phase Grounded Neutral System

This description of a new type of power supply system, should be of vital interest, not only to transmission and distribution engineers but to the majority of power plant engineers as well. While the most important system grounding starts at the source of supply, quite often the transformer, the greatest source of supply is right at the power plant itself. Most engineers are familiar with the four commonly used types of power supply systems in use today but very few know of the new system described in the accompanying article, which is known as the "A" system. This "A" system is the invention of William T. Taylor, noted authority on transformers and distribution systems and whose articles on a new type of armature winding diagram appeared in POWER PLANT ENGINEERING during 1943. As is disclosed, this "A" system has important advantages over the present Delta, "Y", "T", and "V" systems if it becomes necessary to change over from one system to another. With the "A" system such a change can be made with the least disturbance. In fact, this "A" system incorporates all the major and most used 3-phase systems

THE FOUR COMMON power supply systems of today are the "△," the "Y," the "T" and the "V." The "A" system shown herein, which is new, can be operated simultaneously on the same metallic network (transmission or/and distribution) as either the "V," the "T" or the "△" systems. It offers merits where a gradual or partial change-over of a distribution network to a higher voltage is desired because the phase angular relations, common to a change from "△" to "Y," do not alter by changing the system connections, say from "△" to "A" or from "T" to "A" (see Figs. 1 and 2).

Excluding the "T" system, each of the above mentioned transformation systems have their phase windings divided into two equal parts hence the grounding connection can be (and generally is) made at this midway point, and one of the two "T" system transformers can be brought under this category for a conversion. The "V" system is commonly grounded at the apex of the "V" although the center point of any one phase winding may be used. The "T" transformation usually provides a neutral outlet point for grounding but the system itself is of no use for conversion to a higher voltage.

With time, loading and system (overhead line and/or underground cable) extensions, the drop in voltage may become prohibitive, requiring either an increase in the supply voltage or an increase in the cross-section of network copper. Also for other reasons a higher voltage of supply may become necessary and the only common practice of today is to change the system connections from "△" to "Y," assuming the system is "△" connected in the first place. If the transformer system of connections be "Y" then it is already supplying its highest voltage.

For distribution networks in general it is usually impossible to operate two distinct voltages simultaneously on the same metallic network. If the system connections are "△" or 1.000 or 100 per cent, then a change to "Y" would give a higher voltage of $\sqrt{3}\times 1.000$ or 173.2 per cent, but the resulting angular displacement of the phases would not permit operation of the two distinct systems on the one metallic network which may be that of partial change-over of a distribution area to a higher voltage. A change of system connections from "△" to "Y" requires that the entire distribution network be changed over at the one and same time.

Illustrating for greater simplicity, only one side of the transformation system (secondary or primary, as the case may be), Fig. 1 reveals a closed delta or "△" system changed to the "A" or delta-star system. Such a system change may be necessary for two very desirable reasons, namely: (1) to increase the phase line voltage, and (2) to provide a true neutral grounding point.

It is common manufacturing practice to make the windings of single-phase transformers in two equal halves, hence the half or the whole of a phase winding may be used for each extended leg of the "A." Where the whole winding is used it is connected in parallel. Thus the "A" system converted from "△," consists of three parts in each whole leg and two equal parts in the original "△" b-c phase (see Fig. 1). Therefore ordinary stock distribu-

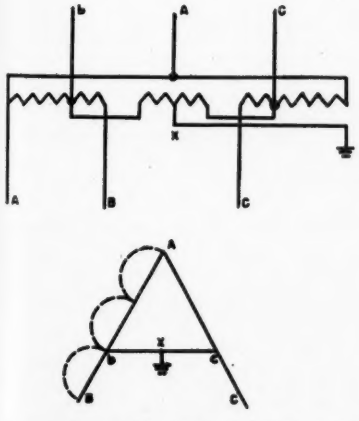


Fig. 1. Closed delta system changed to the "A" or delta-star system

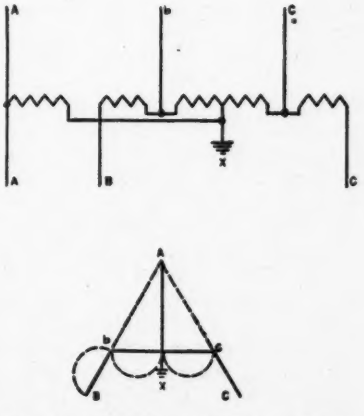


Fig. 2. This diagram shows how the "T" system is converted to the "A" or delta-star system

tion transformers can be used for a change from "△" to the higher voltage without displacement of the phases.

Where it is required to provide a true neutral point and decrease the potential stress from phase to ground, the "V" or open-delta system may be converted to the "A" or delta-star system (without voltage increase) by connecting a ⅔ voltage single-phase transformer across the two open-legs at points ⅔ of their length from the apex of the "V."

The following tabulation represents the different percentage voltages for different system changes:

SYSTEM	Neutral to any one phase lead	Across the "△"	Between "A" phase leads
Original "T"	57.7%	100%	100%
From "T" to "A"	86.6%	100%	150%
Original "△" or "V"	(no neutral)	100%	100%
From "△" to "A"	86.6%	100%	150%
From "V" to "A" (no voltage increase)	57.7%	66.6%	100%
From "V" to "A" (with voltage increase)	86.6%	100%	150%

Figure 2 shows how the "T" system is converted to the "A" or delta-star system with an increase in phase line-voltage of 150 per cent without changing the phase angular relations. This requires less transformer capacity than the "A" system of Fig. 1, assuming the same percentage increase in voltage.

In case of failure in a phase transformer such as A-b or A-c of Fig. 1, the "A" system will continue operating in open-delta though the connections might, if desired, be changed to the "T" system as shown in Fig. 2.

Assuming standard voltage initially and use of the same stock transformers for a change to double the original line voltage (not the "Y" with increase to 173.2 per cent), a conversion from "△" to "A" will limit the maximum increase in potential stress from phase to ground to definitely safe values though the operating voltage is now 200 per cent. For example: assuming the original "△" voltage to be 2400 v and the maximum potential stress to be $0.866 \times 2400 = 2080$ v; then, doubling the phase voltage by use of similar transformers and changing to the "A" system we get 4800 v (standard) with maximum potential stress of only 2800 v. Hence, such a change may better serve the conditions and better solve the distribution problem than a change to the "Y" system.

If the transformers, line insulators and line conductor-spacings are designed for 2400 "△" line voltage, then they will operate safely at 4800 "A" line voltage. Hence, for these standard voltages ordinary transformers and the same primary lines can be used for operating the "A" system at twice the voltage of the "△" system.

Now take a case requiring 50 per cent increase in line voltage, using standard transformers of 2400 or 4800 v and a "△" system. For a system change from "V" or "△" to "A" and for the same maximum potential stress between line and ground, the "A" system permits of a 50 per cent increase in line voltage. Thus, maximum stress for the "△" 4800 v system is $4800 \times 0.866 = 4157$ v and for the "A" 7200 v system it is $7200 \times 0.577 = 4157$ v. Hence, the original 4800 v line can be used for the 7200 v new line voltage.

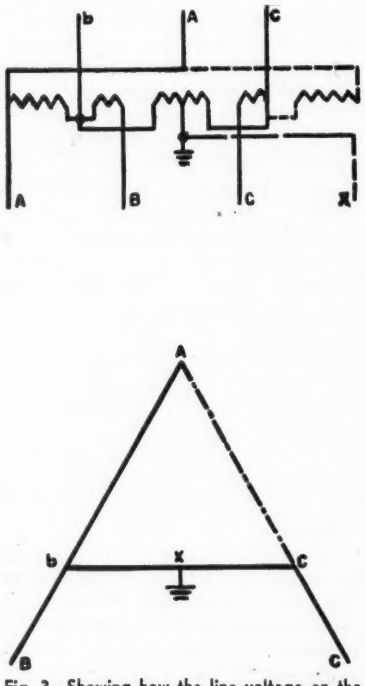


Fig. 3. Showing how the line voltage on the "V" system can be increased

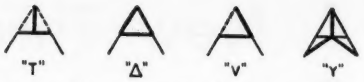


Fig. 4. These diagrams show, how by the use of vectors it can be demonstrated that the "A" system incorporates all the major and most widely employed 3-phase systems

By connecting the "V" or open-delta system as shown in Fig. 3 the line voltage can be increased just the same as shown in the above examples for the closed-delta system. In other words, the loss of a phase transformer does not cripple the "A" system. Operated in "V" it will supply 3-phase power, delta and star on any one side of the system (primary and/or secondary), provide a true neutral grounding point on both sides of the system, permit an increase of 50 per cent or even 100 per cent without a change in line insulators, conductor spacings, angular phase relations, and use of the same stock transformers, etc.

Protection of Buried Pipe Lines

CATHODIC protection as a means of preventing corrosion of buried pipe lines has been widely used for a number of years and experience has shown that a properly designed and maintained system is both satisfactory and economical, according to reports from the National Bureau of Standards.

Until recently, little has been known about the current density necessary to prevent corrosion. The common practice has been to cause current to flow from a buried anode to the structure in sufficient quantities to insure an arbitrarily chosen difference of potential between the structure and a reference electrode, or to cause the potential to decrease by an experimental amount.

It has been shown that the potential of buried steel with respect to a reference electrode in the adjacent soil depends on the aeration and pH value of the soil and that the application of current to a buried structure may gradually raise or lower its potential, depending on the reactions resulting from the flow of current. It follows that neither the potential of the buried structure nor a specified change in the potential necessarily indicates its condition with respect to corrosion.

If buried corroding steel is made a cathode, its true potential with respect to adjacent earth remains constant when the current flowing to the cathode is increased, until the local corrosion currents have been overcome. Application of additional current changes the potential of the cathode in proportion to the logarithm of the additional current. The current just sufficient to change the potential of the cathode is the current required to prevent its corrosion.

The potential of a cathode with respect to a reference electrode in the earth, as usually measured, includes a drop due to resistance in the circuit, and this must be eliminated or deducted if the critical current is to be recognized.

U.S. Navy Cold Storage Plant At Bayonne, N. J.

Great Cold Storage Warehouse at U. S. Naval Supply Depot stores vast quantities of food for our Naval forces . . . Refrigeration supplied by four electrically driven ammonia compressors . . . Brine cooling system used . . . Electrical control equipment fully automatic and of the most modern type . . . Plant supplied with full complement of indicating and recording instruments for dependable and efficient operation . . . Rooms cooled by 90,000 ft of 2-in. brine coils . . . Sea water used for cooling condenser

AMONG the vast array of structures and buildings which make up the great U.S. Naval Supply Depot at Bayonne, N. J., there is one, known simply as Building No. 35, which is of more than ordinary interest to the average individual because of what it contains. This is the cold storage building, a tremendous structure, over 540 ft in length and filled with the most amazing quantity and variety of food conceivable. If anybody still wonders where all the butter and cheese and meat that once decorated our American dinner tables went during the years of war, he need go no farther than Building No. 35 at the Bayonne Supply Depot to be provided with an explanation. Here, he will see great rooms piled high with hundreds of thousands of pounds of cheese, tons upon tons of butter. There will be rooms filled with nothing but lemons and oranges, others lined with hundreds of sides of beef and still others stacked with fish, poultry, vegetables of all kinds. Some of the rooms will have temperatures far below zero, others containing fruits and vegetables with more moderate temperatures around 35 and 40 deg. It is a most interesting place, especially for a hungry person but it will avail him but little for all this food is destined for use in the far-away places of the world where our Navy holds forth. The food remains in this building only temporarily, usually only long enough until it can be loaded into the ships which dock alongside.

In this article, we will concern ourselves not with the food itself but with

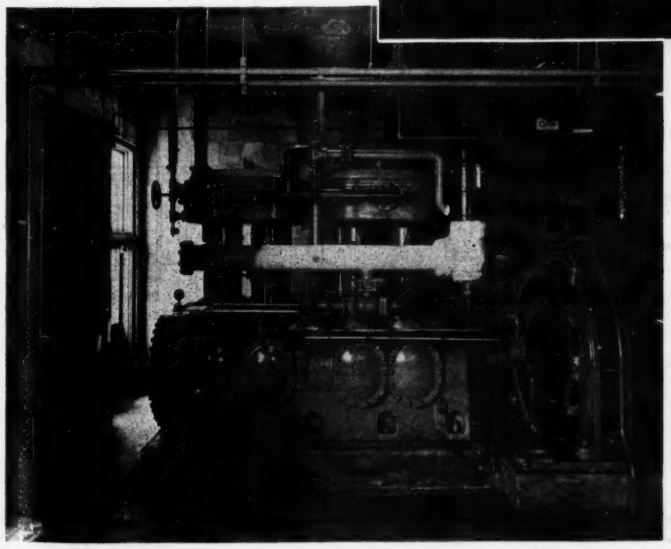


Fig. 1. (Above) A view of the three 2-cylinder compressors. Two 11 by 10s and a 9 by 9 are interconnected with a 4-cylinder 12 by 12 on the other side of the room. The belt-driven exciters it will be noted are mounted on top of the synchronous motor frames

Fig. 2. (Left) The four-cylinder, 12 by 12 compressor. Flexo-Seals are installed on all of the compressors at the Bayonne plant. This machine operates at 240 rpm

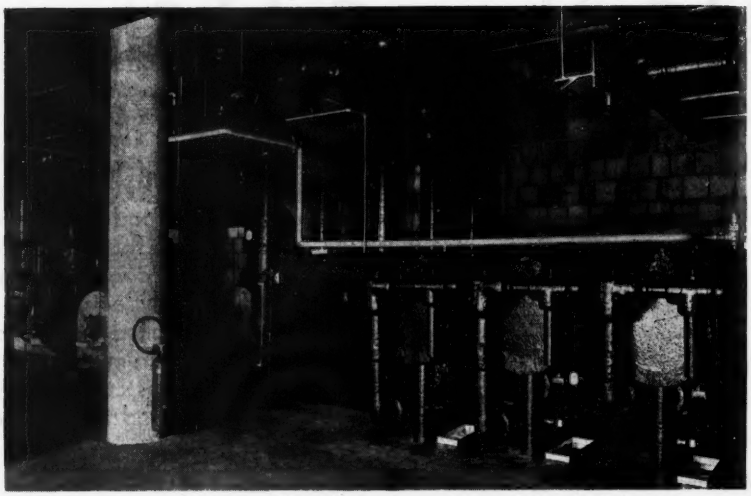


Fig. 3. The system is provided with three 34 in. diam by 15 ft long brine coolers fitted with oil-type liquid level indicators and insulated with granulated cork poured inside a rectangular enclosure of cork board. The brine pumps can be seen behind the building column at the left

the technical aspects of keeping such vast quantities of highly perishable food in good condition, in short, keeping it at the proper temperatures.

Quite obviously, the refrigerating system for a cold storage warehouse of this character is of the utmost importance. To avoid spoilage of the millions of dollars worth of food stored it is imperative that the refrigeration be highly reliable and of adequate capacity. The refrigeration system is, therefore, most modern in design and provided with every control to make its functioning as near foolproof as possible.

The cooling load is carried by a brine system, the brine in turn being cooled in three horizontal shell-and-tube brine coolers, each 34 in. in diam and 15 ft long.

Four electrically driven ammonia compressors are provided. Three of these are two cylinder machines while the fourth is a 12 by 12 in. 4-cylinder unit. The line-up of two cylinder machines includes a 9 by 9 in. unit and two larger compressors, 11 by 10 in. The 9 by 9 machine is equipped with capacity controls and operates at 327 rpm. The 11 by 10's run at 300, and the 4-cylinder compressor turns at a moderate speed of 240 rpm. All compressors are Frick Co. units and all are driven by direct-connected Ideal Electric Co. synchronous motors.

The general arrangement of the refrigerating equipment is shown in Fig. 4. The three 2-cylinder compressors are arranged on one side of the room together with the brine coolers, the brine pumps and the brine mixing tank. The 4-cylinder compressor is located on the other side of the room along with the condenser pumps and the condensers. The three shell and tube condensers use sea water for cooling and are installed in a glass partitioned room. Water from the condenser pumps first passes through the ammonia precooler before it enters the condenser inlet headers. The inlet headers are arranged in the form of a loop so that the water enters the condenser water boxes from two sides. The two all-welded ammonia receivers are also located in the condenser room.

The refrigeration system normally contains about 7500 lb of ammonia. Ten 100 lb drums, a total of 1000 lb, of ammonia are kept on hand at all times for use in case of emergency. These 10 drums of ammonia are stored in a rack just outside the condenser room. In case additional ammonia is required in the system, the operators can roll the drums to the door of the condenser room and hose is always kept on hand whereby the ammonia can be transferred from the drums to the ammonia receivers.

The system is provided with three brine coolers and four brine pumps. The brine coolers are equipped with oil-type liquid level indicators, and are insulated with granulated cork poured inside a rectangular enclosure of cork board.

The brine is circulated by two pumps of 500 gpm capacity, one of 800 gpm capacity and a fourth of 1000 gpm capacity. These are driven by 20 and 30 hp, 1200 rpm, 220 v induction motors. The brine is handled at two temperatures; in one instance the brine leaves the coolers at 24 deg and in the other, at minus 20 F.

A brine mixing tank is provided together with a small motor-driven pump for circulating the brine during the mixing operation. This tank is located alongside of the brine circulating pumps. The flow of brine is metered by a Builders Iron Foundry venturi meter using a manometer indicator.

As with other installations operated by the Navy, this refrigerating plant is complete with everything necessary for the most dependable and efficient operation. Two 10-in. recording gages register the gas pressures; nearly 50 thermometers are used to check the operation of compressors, condensers, brine coolers, fan units, etc. An ammonia helmet, refrigerant mixer, and special valve box are furnished for fire department use.

The electrical equipment is especially complete, and the control is highly automatic. The synchronous motors supplying the four compressors are all 4160 v machines. Each motor has its individual control panel in a 9-panel metal enclosed Westinghouse switchboard. Starting a machine is a simple procedure. After both suction and discharge valves are opened and the oil level in the crankcase is checked, the motor is started at the switchboard. As the motor is an induction motor, a solenoid is energized which opens an automatic valve permitting the discharge to by-pass into the suction. The instant the motor is synchronized, the solenoid is de-energized which unloads the automatic by-pass, closing it, and the compressor is on the line. The power factor of the motor is then adjusted by control of the field rheostat.

A 60-cell Exide storage battery supplies the direct current for the opera-

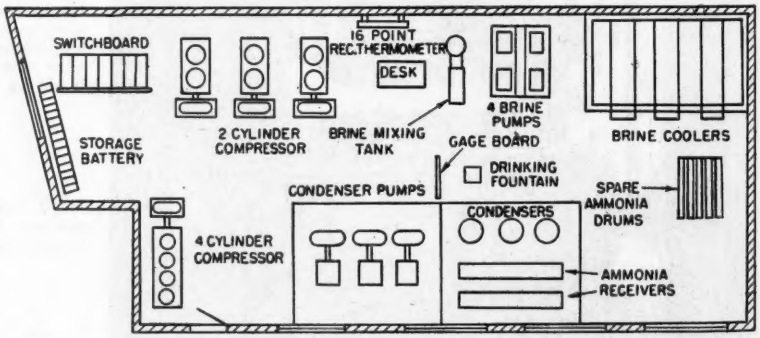


Fig. 4. A plan of the refrigerating equipment room showing the arrangement of the equipment. The ammonia condensers are installed in a separate room having glass partitions

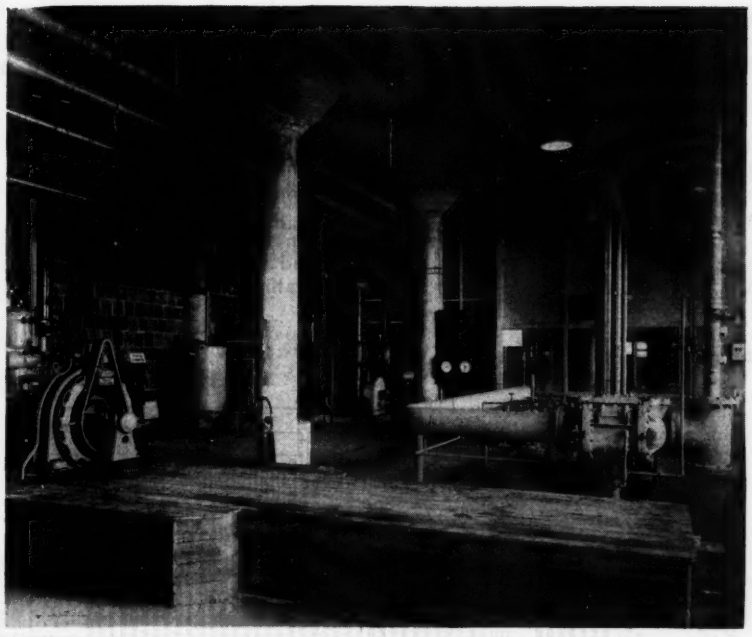


Fig. 5. A general view of the refrigerating plant showing the condenser pumps in the foreground at the right and the condenser room at the rear. The brine mixing tank can be seen just to the right of the compressor at the left

tion of the circuit breakers and control equipment. This is charged by a Westinghouse "Rectox" rectifier mounted on the wall above the battery. The battery is installed at the end of the room alongside of the switchboard.

The freezer room is cooled by approximately 90,000 ft of 2-in. brine coils, welded on the job from 40-ft lengths of full weight pipe. Eighteen suspended and brine-spray type air cooling units are installed in the egg, fruit and vegetable rooms. Eighteen thermostats and the same number of control valves are provided. Other control equipment includes four high-pressure cutouts, and four sets of water failure pressure switches, alarm bells, transformers, and 4-pole relays for the pumps.

List of Principal Equipment in the U. S. Naval Supply Depot Refrigerating Plant at Bayonne, N. J.

AMMONIA COMPRESSORS

1 Four Cylinder, 12 by 12, Type SMM Frick Co. compressor, capacity 186 tons at 85 per cent efficiency and standard conditions, Driven by a 250 hp, 240 rpm, 4160 v 3-phase, 60 cycle Ideal Electric Co. synchronous motor with belt driven exciter mounted on the frame of the motor

2 Two cylinder, 11 by 10, Frick Co. compressors, capacity 81 tons at 85 per cent efficiency. Driven by 125 hp, 300 rpm, 4160 v Ideal Electric Co. synchronous motors with belt driven exciters mounted on frames

1 Two cylinder, 9 by 9, Frick Co. compressor, capacity 55 tons at 85 per cent efficiency. Driven by a 75 hp, 327 rpm, 4160 v Ideal Electric Co. synchronous motor with belt driven exciter mounted on frame

AMMONIA CONDENSERS

3 Vertical shell-and-tube condensers, Frick Co., 32 in. in diam by 14 ft high

BRINE COOLERS

3 Horizontal shell-and-tube brine coolers, Frick Co.

PUMPS

4 Goulds Pumps Inc. centrifugal brine pumps one 1000 gpm, one 800 gpm and two 500 gpm capacity. All are driven by Ideal Electric Co., 220 v induction motors

3 Goulds Pumps Inc., condenser pumps, one 200 gpm, one 400 gpm and one 600 gpm capacity all driven by Ideal Electric Co., 220 v induction motors.

1 Brine mixing pump, 40 gpm

AMMONIA RECEIVERS

2 All welded construction

SWITCHBOARD

1 9-panel metal enclosed Westinghouse Electric & Mfg. Co. switchboard installed by Peters & Peters, Inc.

STORAGE BATTERY

1 60-cell Exide Storage battery with Westinghouse "Rectox" Charger.

MISCELLANEOUS EQUIPMENT

Brine meter. Builders Iron Foundry, venturi meter with manometer indicator

Oil purifiers. Honan Crane

Portable oil pumps and tanks. Bowser

Hydroelectric Developments Planned for Brazil

IN LINE with the intensive economic progress that is taking place in Brazil, the Inter-American Development Commission reports that Brazil has under way or planned more than ten projects for construction or improvement of hydroelectric plants which would more than double the capacity of the country for electric power production.

Plans are made to expand the capacity of the existing stations of Ribeirao das Lagos in the State of Rio de Janeiro by about 40,000 kw through the construction of a new dam and tunnel. This state is the second largest consumer of electric power, taking about 26 per cent of the total Brazilian production.

In the State of Sao Paulo, at the Usina do Cubatao the capacity is to be increased by about 55,000 kw by the installation of a new generator, tunnel widening and other work. The State of Sao Paulo, the center of Brazilian industries, contains about 46.7 per cent of the power production installations of the country. The Cubatao station has a potential capacity of 1,000,000 hp, of which 300,000 hp is installed.

A new hydroelectric station with two generating units of 10,000 kw is to be constructed in Avanhandava by the Empresas Eletricas Brazileiras in the State of Sao Paulo.

Construction of the Macabu plant in the State of Rio de Janeiro is now underway.

Three plants with a combined capacity of 85,000 kw are to be built in the State of Rio Grande do Sul, center of the cattle raising and agriculture industries and possessor of a number of other important industries.

One of the largest projects in the program is to be located on the Sao Francisco River on the boundary between the States of Bahia and Alagoas. This plant is to have a capacity of 500,000 kw and its construction is to mark the first step in an extensive program for the industrial and agricultural development of the rich northeastern territories.

In the mineral-rich State of Minas Gerais, the Rio Pardo Basin and the Rio Doce Valley are to be the sites of sizable projects to support the economic development of both regions. The basin holds deposits of zirconium and high quality bauxite. This valley leads to rich iron ore reserves, and deposits of mica and manganese are located in the valley.

As planned today, this program of hydroelectric power development will provide well in excess of 1,230,000 kw of additional electric power generating capacity and will about double the present capacity. A survey conducted by the Brazilian Commission of Inter-American Development gives an estimate of potential hydraulic power for the country of over 20,000,000 hp.

A Look at the Nation's Coal Pile

Coal production near capacity of mines . . . Coal stocks below desired quantities but increasing . . . Among industrial consumers, electric utilities carry highest reserves . . . Ten per cent of electric utility stock is anthracite . . Electric power weekly production now at 1943 figure . . . Steel production curve now lower than for 1943 . . . Estimated coal production for 1944, 16,000,000 tons short of estimated requirements . . . Users urged to follow SFAW suggestions in purchase, storage and use of fuel for generating steam

BY RALPH E. TURNER, Editor, Power Plant Engineering

DURING the winter of 1942-'43 acute suffering among the users of fuel, particularly for heating purposes, was brought about by the existing war conditions. Many of the difficulties were the direct result of the submarine activities carried on along the Atlantic coast. Particularly acute was the shortage of fuel oil. This fuel had become popular not only for residential and apartment house use but many power generating plants were depending upon oil for fuel.

Conditions have changed radically in the past two years. Not only have war activities of the enemy along the coast been subdued, but oil burning plants have, in large measure, been converted to the use of coal. This change has placed a greater burden on the coal industry to supply the needs of the country. So acute has the situation been during this entire year that Government agencies have continuously been warning the public of an impending shortage of fuel this coming winter and strongly urging fuel users to order their winter fuel needs during the summer season when transportation is most convenient and dealers can give their customers more careful consideration.

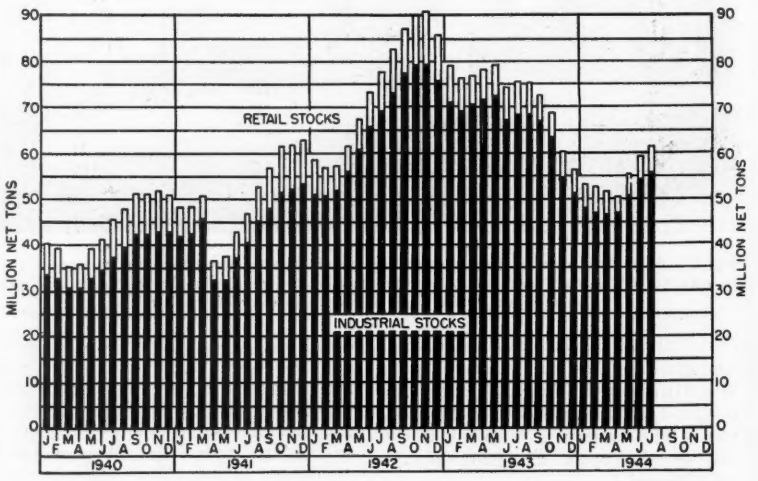


Fig. 1. Stocks of bituminous coal and lignite in the hands of commercial consumers and retailers

Adopting a policy designed to bring about higher efficiency in the use of fuel, more even distribution among users in all sections of the country, and more uniform production of coal throughout the year, the U. S. Department of the Interior appointed the National Fuel Efficiency Council, with Thomas C. Cheasley as chairman, which with nearly 150 area coordinators and 5000 volunteer regional engineers has inaugurated a program of

Table I. Stocks and consumption of bituminous coal and lignite in the United States

	July, 1944 (preliminary)	June, 1944 (revised)	Percent of change
STOCKS, END OF MONTH, AT:	Net tons		
Electric power utilities *a*	16,965,000	16,457,000	+ 3.1
Byproduct coke ovens	5,736,000	6,152,000	— 6.8
Steel and rolling mills	806,000	785,000	+ 2.7
Coal-gas retorts *a*	216,000	206,000	+ 4.9
Cement mills	508,000	491,000	± 3.5
Other industrials *b*	17,529,000	16,839,000	+ 4.1
Railroads (Class I) *c*	13,793,000	13,329,000	+ 3.5
Total industrial stocks	55,553,000	54,259,000	+ 2.4
Retail dealer stocks *b*	5,876,000	5,421,000	+ 8.4
Grand total	61,429,000	59,680,000	+ 2.9
	Total by months		
MONTHLY CONSUMPTION BY:	Net tons		
Electric power utilities *a*	6,416,000	6,167,000	+ 4.0
Byproduct coke ovens	8,007,000	7,778,000	+ 2.9
Beehive coke ovens	946,000	958,000	— 1.3
Steel and rolling mills	773,000	778,000	— .6
Coal-gas retorts *a*	117,000	112,000	+ 4.5
Cement mills	316,000	311,000	+ 1.6
Other industrials *b*	8,468,000	8,961,000	— 5.5
Railroads (Class I) *c*	10,253,000	10,230,000	+ .2
Total industrial	35,296,000	35,295,000	—
Retail dealer deliveries *b*	7,917,000	7,777,000	+ 1.8
Grand total	43,213,000	43,072,000	+ .3
ADDITIONAL KNOWN CONSUMPTION:			
Coal mine fuel	228,000	248,000	— 8.1
Bunker fuel, foreign trade	(d)	(d)	

	July, 1944 (preliminary)	June, 1944 (revised)	Percent of change
	Days' supply		
DAYS' SUPPLY, END OF MONTH, AT:			
Electric power utilities	82 days	80 days	± 2.5
Byproduct coke ovens	22 days	24 days	— 8.3
Steel and rolling mills	32 days	30 days	+ 6.7
Coal-gas retorts	57 days	55 days	± 3.6
Cement mills	50 days	47 days	± 6.4
Other industrials	64 days	56 days	± 14.3
Railroads (Class I)	42 days	39 days	+ 7.7
Total industrial	49 days	46 days	± 6.5
Retail dealer	23 days	21 days	± 9.5
Grand total	44 days	42 days	± 4.3
		Daily average	
DAILY CONSUMPTION BY:	Net tons		
Electric power utilities	206,968	205,567	+ 0.7
Byproduct coke ovens	258,290	259,267	— .4
Beehive coke ovens	30,516	31,933	— 4.4
Steel and rolling mills	24,935	25,933	— 3.8
Coal-gas retorts	3,774	3,733	+ 1.1
Cement mills	10,194	10,367	— 1.7
Other industrials	273,161	298,700	— 8.6
Railroads (Class I)	330,742	341,000	— 3.0
Total industrial	1,138,580	1,176,500	— 3.2
Retail dealer deliveries	255,387	259,333	— 1.5
Grand total	1,393,967	1,435,833	— 2.9
ADDITIONAL KNOWN CONSUMPTION:			
Coal mine fuel	7,355	8,267	— 11.0
Bunker fuel, foreign trade	(d)	(d)	

(a) Collected by the Federal Power Commission (b) Coverage has been considerably increased since July 1, 1943. (c) Collected by the Association of American Railroads. Includes powerhouse, shop, and station fuel. (d) Figures not available for publication.

Table II. Industrial stocks of bituminous coal and lignite by regions in terms of day's supply

	New England	Middle Atlantic	Ohio	Michigan	Illinois-Indiana	Lower Missouri Valley	Lake dock territory	Southeast	Southwest, Mountain, and Pacific	Total all regions
ELECTRIC POWER UTILITIES										
1944—August 1	105	76	57	90	82	91	149	78	170	82
July 1	98	77	57	87	74	78	142	86	152	80
1943—August 1	109	71	68	155	92	66	171	103	83	89
BYPRODUCT COKE OVENS										
1944—August 1	30	20	17	32	21	(a)	128	17	17	22
July 1	30	23	18	31	21	(a)	116	19	17	24
1943—August 1	29	23	24	51	34	(a)	129	21	11	28
STEEL AND ROLLING MILLS										
1944—August 1	68	26	32	(a)	68	(a)	—	23	(a)	*b* 32
July 1	99	26	30	(a)	62	(a)	—	21	(a)	*b* 30
1943—August 1	139	28	29	(a)	72	(a)	—	41	(a)	*b* 33
COAL-GAS RETORTS										
1944—August 1	59	63	34	46	59	(a)	75	37	23	57
July 1	64	53	34	40	63	(a)	72	32	23	55
1943—August 1	91	66	76	72	113	(a)	136	41	33	85
CEMENT MILLS										
1944—August 1	(a)	37	26	73	30	91	(a)	28	36	*b* 50
July 1	(a)	38	22	67	19	80	(a)	27	32	*b* 47
1943—August 1	(a)	37	30	37	23	65	(a)	29	20	*b* 40

(a) Included in total to avoid disclosure. (b) Includes certain large companies reporting national totals only.

Table III. Stocks of industrial anthracite held by industries (net tons) (a)

	July 1944 *b*	June 1944	Percent of change From previous month	Percent of change From year ago
ELECTRIC POWER UTILITIES *c*				
Stocks, end of month	1,628,373	1,646,675	— 1.1	— 4.8
Consumed during month	296,776	278,283	+ 6.6	— .8
Days' supply, end of month	170 days	178 days	— 4.5	— 4.0
RAILROADS (CLASS I) *d*				
Stocks, end of month	165,637	141,138	+ 17.4	— 9.6
Consumed during month	69,719	72,780	— 4.2	— 9.3
Days' supply, end of month	74 days	58 days	+ 27.6	—
OTHER INDUSTRIAL CONSUMERS				
(Selected representative plants *e*)				
Stocks, end of month	884,549	870,755	+ 1.6	(f)
Consumed during month	202,568	222.517	— 9.0	(f)
Days' supply, end of month	135 days	117 days	+ 15.4	(f)
RETAIL DEALERS				
(Selected representative plants *g*)				
Stocks, end of month	723,492	648,448	+ 11.6	(f)
Delivered during month	1,124,548	1,270,180	— 11.5	(f)
Days' supply, end of month	20 days	15 days	+ 33.3	(f)

(a) Anthracite in producers' storage yards reported by Anthracite Committee, Commonwealth of Pennsylvania, Department of Commerce, amounted to 378,340 tons on August 1 and 347,868 tons on July 1. (b) Subject to revision. (c) Collected by the Federal Power Commission. (d) Collected by the Association of American Railroads. (e) Represents 714 identical consumers in June and July, 1944. (f) Data not available on a comparable basis. (g) Represents 3,648 identical dealers for June and July, 1944.

Table IV. Upper Lake dock trade in total coal

(Compiled by cooperative arrangement in which Maher Coal Bureau covers Duluth-Superior and Ashland-Washburn, and other commercial operators report direct to Bureau of Mines. Includes all commercial American docks on Lake Superior and on the west bank of Lake Michigan as far south as Racine and Kenosha, Wisconsin, but not including Waukegan and Chicago, Illinois.)

BITUMINOUS COAL	July 1944 *a*	June 1944	Calendar year to date 1944	Calendar year to date 1943	Percent of change
RECEIPTS					
Lake Superior	1,275,802	1,327,161	4,361,722	3,344,507	+ 30.4
Lake Michigan	637,037	719,529	2,696,022	*b* 2,013,707	+ 33.9
Total	1,912,839	2,046,690	7,057,744	*b* 5,358,214	+ 31.7
DELIVERIES (RELOADINGS)					
Lake Superior	664,987	717,399	4,951,763	5,572,225	— 11.1
Lake Michigan	360,651	383,723	2,985,129	*b* 3,291,829	— 9.3
Total	1,025,638	1,101,122	7,936,892	*b* 8,864,054	— 10.5
STOCKS, END OF MONTH					
Lake Superior	3,093,658	2,484,759	*c* 3,093,658	*d* 2,191,584	+ 41.2
Lake Michigan	1,652,476	1,376,090	*c* 1,652,476	*d* 1,353,275	+ 22.1
Total	4,746,134	3,860,849	*c* 4,746,134	*d* 3,544,859	+ 33.9
ANTHRACITE					
RECEIPTS					
Lake Superior	96,187	*e* 102,945	*e* 235,344	23,709	*e*+892.6
Lake Michigan	55,417	61,445	209,929	132,030	+ 59.0
Total	151,604	164,390	445,273	155,739	+185.9
DELIVERIES (RELOADINGS)					
Lake Superior	39,108	*e* 53,044	*e* 125,866	49,535	*e*+154.1
Lake Michigan	31,085	36,025	186,454	191,840	— 2.8
Total	70,193	89,069	312,320	241,375	+ 29.4
STOCKS, END OF MONTH					
Lake Superior	165,217	*e* 108,138	*c e* 165,217	*d* 27,127	*e*+509.1
Lake Michigan	109,531	85,199	*c* 109,531	*d* 46,181	+137.2
Total	274,748	193,337	*c* 274,748	*d* 73,308	+274.8

(a) Subject to revision. (b) Revised. (c) Represents stocks end of month for July 1944. (d) Represents stocks end of month for July 1943. (e) Through an error on the part of one of the reporting docks, a certain tonnage of anthracite dust or silt used in briquet manufacture was not reported at the proper time, and all of this tonnage has been included in the June report.

instruction to users and investigation of troublesome fuel situations that will reach every phase of fuel use. This Council is determined to do everything possible to avert a fuel crisis this coming winter but it will need the full co-operation of all fuel users.

Indications are that sufficient coal will be available if precautions are taken by individual users to estimate carefully their requirements, order well in advance that which is expected to be used, keep in storage from one to three months' supply, burn fuel efficiently, use heat and power without waste.

Coal in Storage

Contingencies are always likely to arise which will prevent regular delivery of coal to a power plant. Rail or ship transportation may be interrupted due to weather conditions, accidents or labor difficulties. One man's guess is as good as another's as to how long interruptions may last, but it is never safe for a boiler plant to be without fuel enough to last at least one month without deliveries being made. Utilities have made it a practice to stock up coal during the summer so that by the time winter sets in they have three to four months' supply on hand. Regular deliveries are continued so far as possible and the stock pile is resorted to only during emergencies. Stocks are replenished as the coal becomes available.

Other industries, as a rule, do not stock up their fuel reserves to the extent that utilities do and it is to these plants that the greatest appeal is being directed to stock coal for the coming winter. Although a number of these industries depend upon coal as raw material for their manufactured product, such as coke and gas, the manager of the power plant serving any factory, institution, building or any industry should make certain that the allotment for steam and power generation is adequate and a sufficient quantity is kept in storage for emergency use.

In the chart, Fig. 1, are plotted the amounts of bituminous coal and lignite held in stock by industries and retail dealers over the past five year period. In general, the chart indicates that stocks reach their low point in the spring months and are built up to a high in November or December. The one exceptional year was 1943 when stocks decreased almost continuously from May of '43 to March of '44 since which time stocks have made a substantial increase. How the various industries participated in this increase is indicated by the figures in Table I which shows two months' operation. Inasmuch as the problem of storage must be answered for individual plants in various districts of the country, Table II may be helpful for it shows how the bituminous and lignite supplies varied not only by industries but also by regions. Almost invariably greater supplies are carried in those regions farthest from the coal producing areas.

That industrial anthracite is used to a considerable extent by electric power utilities is noted in Table III which indicates that the amount held in storage, the country over, is about one-tenth that of bituminous coal and lignite. Its use, however, is confined principally to plants in the regions near the anthracite mines. Trends in recent shipment of coal to various districts are shown in Tables IV and V. These figures change from week to week with extreme variation in transportation difficulties. The Great Lakes, for instance, are frozen over in winter and fuel movement by boats is completely stopped for several months. Plants depending solely upon such delivery of fuel must of necessity stock up sufficient fuel to carry them over the winter. Other plants may be so situated that coal may come by rail as well as water but it is difficult to determine how dependable either or both of these means of transportation may be under unpredictable weather conditions until after the season is over.

With the exception of some short periods when miners were on strike, coal production during the past two years has been remarkably uniform throughout the year with the greatest output in the period from November '43, to the middle of February '44. Holidays and minor labor disturbances have caused fluctuations but as a rule the mines have been producing at close to their full capacity, and under these circumstances users cannot depend upon additional output in case the demand becomes acute during the coming winter when the call for residential fuel is greatest. Figure 2 and Table VI give data pertinent to production rates.

On the basis of consumer use of coal during 1943, the Solid Fuels Administration for War has made estimates of requirements for 1944. These figures are as follows:

Consumer	1943 Consumption Thous. Tons	1944 (Estimated) Requirements Thous. Tons
Electric power utilities	76,400	80,000
By-product coke	90,400	96,000
Beehive coke	12,500	11,300
Steel and rolling mills	11,200	11,000
Coal gas retorts	1,700	1,700
Cement mills	5,900	3,500
Other industry	145,000	150,500
Railroads	138,000	142,000
Retail dealers	128,000	130,000
Total	609,100	626,000

Estimates made by SFAW on July 1 indicate that for the coal year beginning April 1, 1944, at the prevailing rates of production there will be a deficit of 16,000,000 tons, most of which will be in the Southern Appalachian coals which are essential in making steel and widely used in residential heating throughout the eastern half of the United States. The production of bituminous coal last year was 589,000,000 tons which was 26,000,000 tons short of the year's consumption, and accounts for the dip early this year in the amount of coal in storage.

These data, all secured from Government reports up to September 15, most certainly indicate that the stock on hand early next spring will be below that of last spring unless conditions of production and consumption change radically in the next few months. To alleviate undesirable pending conditions, SFAW is using all means available to increase coal production, to have it distributed as equitably as possible among users and to have it used efficiently in all cases. The success of the program depends upon the co-operation of coal users, each individual of whom can aid in bettering conditions.

Predictions cannot be made solely upon statistics, such as are given above, for in large measure the conditions that will exist next winter will be the result of a combination of widely varying circumstances developing during the immediate future. Some of these conditions will be unfavorable, others favorable and authorities differ as to the ultimate result. Users will do well to give consideration to all influencing factors in formulating their coal buying policies so an attempt is made here to list the most important unfavorable and favorable conditions that have a bearing on next winter's coal supply.

Unfavorable Aspects

Manpower for mining has, since the beginning of the war, been decreasing continuously and young men are still being called into service out of the coal mines.

The 55,000,000-ton stock pile accumulated by industries does not offset the seriousness of the estimated difference between production and consumption, since these stock piles are principally in the hands of large users and in regions farthest from the producing areas. This stock pile is considerably below that of last year.

Miners now at work are older than during prewar days, average age then 32 years, now 45 with the upward trend continuing and the trend in the rate of production per man-hour is downward.

Table V. Weekly coal distribution statistics

	Week ended Sept. 9, 1944	Week ended Sept. 2, 1944	Week ended Sept. 11, 1943	January 1 to date Sept. 9, 1944	January 1 to date Sept. 11, 1943
Carloadings, f.o.b. mines, cars a					
Bituminous and lignite	181,077	194,561	190,466	7,216,125	6,690,600
Anthracite	18,892	21,665	19,687	735,094	695,667
Lake loadings, net tons b					
Bituminous, cargo	1,414,409	1,738,583	1,387,387	36,738,532	28,746,049
Bituminous, vessel fuel	40,723	56,758	42,227	1,047,374	907,508
Bituminous, total	1,455,132	1,795,341	1,429,614	37,785,906	29,653,557
Anthracite, total	45,662	13,579	25,524	e 750,083	403,302
New England all-rail, cars c					
Bituminous	3,085	3,668	3,590	137,094	148,643
Anthracite	2,229	2,562	2,046	86,785	80,415
Cincinnati gateway, cars interchanged d					
Bituminous	10,128	11,519	11,301	398,588	406,476

	Week ended Sept. 2, 1944	Week ended Aug. 26, 1944	Week ended Sept. 4, 1943
Unbilled loads, bituminous and lignite a			
Number of cars at mines or classification yards	1,696	1,838	1,253
Equivalent net tons	85,000	92,000	63,000

(a) Courtesy of Association of American Railroads. Figures of loadings f.o.b. mines include railroad fuel for company use and therefore differ from the familiar statistics of revenue freight often quoted by the carriers. (b) Ore and Coal Exchange. (c) Association of American Railroads. A small part of this tonnage remains in New York State. Accumulations are for 37 full weeks. (d) Cincinnati Superintendents Committee. Week closes at midnight, Thursday. (e) Revised.

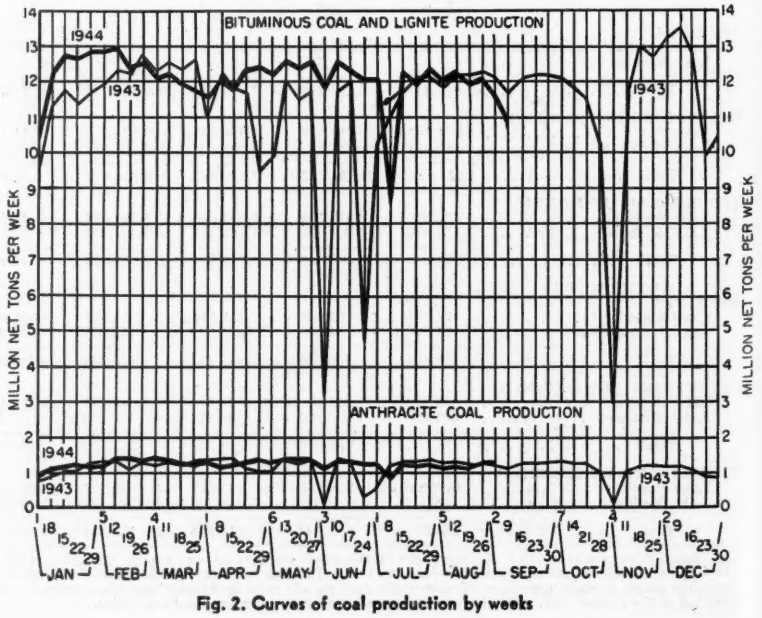


Fig. 2. Curves of coal production by weeks

The most serious shortage of bituminous coal is in the high grade varieties most valuable for steel making and desired by householders particularly in the eastern part of the country.

Miner strikes are taking place in a number of localities to such an extent as to require Government operation. Lost production during the week ending September 9 amounted to 790,000 tons from this cause and the observance of Labor Day.

Conversion from oil to coal burning equipment has taken place in many plants and homes which calls for more coal production.

Shipments of bituminous coal by water to Great Lakes docks up to August 27 were on schedule in tonnages barely sufficient to meet estimated 1944-'45 requirements.

Manpower shortage in some coal yards has caused stocks to pile up while in others lack of order and/or consumer acceptances have brought the same result.

Acute shortage of high-grade Appalachian coals for coke and by-products has caused SFAW to divert 1,680,000 tons of this fuel to steel plants from industrial plants using it for steam generating purposes.

The most efficient fuel burning equipment is not sufficiently available to effect greatly the 1944-'45 requirements. Industries have lost a large share of their skilled boiler room operating staffs to the armed forces and war industries, with resultant drop in fuel burning efficiency.

Manufacturers of materials for conducting the war must not slacken until the need is over, and the war industries require a substantially large portion of the nation's coal supply.

Favorable Aspects

Those who view the situation optimistically point to such conditions as the following to support their conclusions that a real crisis can and will be averted:

If the rate of production can be maintained at the average for the first eight months of the year, the 1944 production of bituminous coal will be more than 680,000,000 tons which is considerably more than the estimated requirements of 626,000,000 tons.

On August 1 there were more than 60,000,000 tons of coal in stock piles of retailers and industrial consumers—a tonnage equal to 41 days' supply—considerably more than was kept in stock during peace times.

Better labor relations exist in mines turned back to the owners after they have been operated by the Government. This action is conducive to greater production.

An increase of about 1,500,000 tons of domestic coke is anticipated this year as compared with 1943. Production of briquettes made from anthracite fines together with Pocahontas slack is expected to be greater this year than last and should help to alleviate critical conditions.

Household stokers are being installed in increasing numbers, their efficiency is much higher than can be secured by hand firing and they permit use of a lower grade fuel.

WPB has announced plans to remove controls over materials when Germany is defeated. This will stimulate installation of modern high efficiency burning equipment and controls.

Electric power production by the public utilities this year has not shown the increase many had expected and is now about on a level with the 1943 load curve.

Production of steel is currently running at about 94 per cent of the country's capacity compared with 99.6 per cent over the same period of last year. In 1943 this industry consumed 90,905,000 tons of coal. A reduction of 5 per cent from last year for the remainder of 1944 would represent about 1,500,000 tons of coal which would be available for other uses.

Optimists look for the complete defeat of Germany within a few weeks, followed almost immediately by a reduction in production of war materials of about 40 per cent and relief in the manpower situation which would reduce coal requirements, permit greater production and assist transportation and distribution.

Coal Buying Is Restricted

Coal users will not be permitted complete freedom in the purchase of coal although SFAW is not planning a rationing system but is, for the present at least, depending upon the patriotism and co-operation of the general public and members of the coal industry to effect distribution in such a way as to prevent hardship and hoarding. Under present rulings, householders are allowed only ⅞ of normal tonnages of anthracite and 9/10 of their usual deliveries of Southern Appalachian coals for next winter. Industries, likewise, should make every effort to save their fuel by increased efficiency in the boiler plant and by reducing the waste of heat and power produced by the plant. In many plants engineers believe 10 per cent can be saved, others, however, that have been provided with modern equipment and kept in good condition will have difficulty in reducing their fuel requirements as much as 5 per cent. The effort, however, on the part of the fuel user and the engineering staff will be well repaid, for only by concerted study of the problems involved can progress be made.

As a reminder to operators the following waste saving instructions have been formulated by NFEC and are available in poster form for plant use:

1. Keep undesirable water out of coal.
2. Keep the larger and the smaller sizes of coal well mixed.
3. Keep fuel-burning equipment clean, and in good repair.
4. Keep all automatic equipment and controls oiled and in proper adjustment.
5. Keep draft or suction in the furnace as low as possible; for stokers, use as low a wind-box pressure as possible.
6. Keep dampers and damper bearings in good condition.

(*Continued on page* 120)

Table VI. Estimated weekly production of coal by states, in net tons

(The current weekly estimates are based on railroad carloadings and river shipments and are subject to revision on receipt of monthly tonnage reports from district and State sources or of final annual returns from the operators.)

State	Week ended September 2, 1944	Week ended August 26, 1944	Week ended September 4, 1943
Alabama	371,000	380,000	373,000
Alaska	5,000	5,000	4,000
Arkansas and Oklahoma	85,000	87,000	94,000
Colorado	143,000	142,000	165,000
Georgia and North Carolina	1,000	1,000	*
Illinois	1,415,000	1,437,000	1,507,000
Indiana	538,000	544,000	541,000
Iowa	40,000	45,000	49,000
Kansas and Missouri	160,000	134,000	158,000
Kentucky—Eastern	955,000	1,020,000	941,000
Western	348,000	350,000	318,000
Maryland	38,000	41,000	36,000
Michigan	2,000	2,000	2,000
Montana (bituminous and lignite)	100,000	106,000	92,000
New Mexico	34,000	34,000	38,000
North and South Dakota (lignite)	50,000	41,000	35,000
Ohio	630,000	700,000	628,000
Pennsylvania (bituminous)	2,637,000	2,735,000	2,996,000
Tennessee	138,000	136,000	138,000
Texas (bituminous and lignite)	3,000	2,000	3,000
Utah	140,000	137,000	106,000
Virginia	370,000	374,000	388,000
Washington	34,000	37,000	28,000
West Virginia—Southern *a*	2,155,000	2,229,000	2,277,000
Northern *b*	1,080,000	1,181,000	1,004,000
Wyoming	167,000	170,000	170,000
Other Western States *c*	1,000	*	*
Total bituminous and lignite	11,640,000	12,070,000	12,091,000
Pennsylvania anthracite	1,316,000	1,290,000	1,260,000
TOTAL, ALL COAL	12,956,000	13,360,000	13,351,000

(a) Includes operations on the N. & W.; C. & O.; Virginian; K. & M.; B. C. & G.; and on the B. & O. in Kanawha, Mason, and Clay counties. (b) Rest of State, including the Panhandle District and Grant, Mineral, and Tucker counties. (c) Includes Arizona and Oregon. *Less than 1,000 tons.

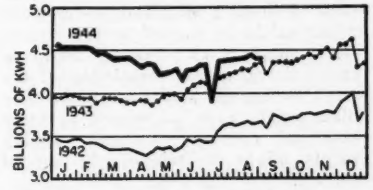


Fig. 3. Weekly production of electric power for public consumption in billions of kilowatthours

The Barge "*ELECTRA*"

New floating Diesel Electric Power Plant constructed by the U. S. Engineers for use on the Pacific Coast on large construction projects . . . Power is generated by eight, 1350 hp, 16 cylinder Diesel engines each driving a 750 kva 2400 v generator . . . Auxiliary load carried by two 150 kw, 240 v engine driven generators . . . Voltage stepped up to 12,000 v by three 2000 kva transformers for transmission

THE UNITED STATES ENGINEERS have just completed construction of a barge-mounted, Diesel-electric power plant with capacity adequate to light a city of 15,000.

While on the Pacific Coast there is ample generating capacity to supply normal needs, instances have arisen where it has been found uneconomical or impossible to extend transmission facilities for the short duration of construction projects. It is obvious that to attempt to start a construction job that would demand 15 or 20 per cent of the total generating capacity of a utility, would curtail power supply to other customers.

It was therefore decided to construct a floating electrical power plant which could be moved to the site of work, supply such power as might be required and at the completion of the work, be moved to the next job. The plant might even be moved to some zone of operations where existing plants might be temporarily out of service.

In designing this plant, the time element was important. The country was combed for existing equipment that could be gathered together at the earliest possible date. The Navy had for transfer to the Army a steel barge which proved to be ideal for the hull section of the plant. This barge is 175 ft long, with a 45 ft width and 11 ft depth. The same source also supplied ten 1350 hp, 750 rpm, 16 cylinder Diesel engines which had previously been removed from certain ships and replaced by engines of larger horsepower.

Attention was next directed to the procurement of generators to be driven by these engines. It was found that these would have to be manufactured. Considerable thought was given to rotor design in order to avoid introducing serious criticals in the crankshafts of the engines at operating speeds. The crankshafts had known tortional characteristics. It was necessary to design a rotor and shaft to work with this known or fixed condition. After the first unit was completed, a torsograph test was run. No criticals were present within the operating range. As space was a factor in crowding maximum generating capacity into a single barge, it was decided to use anti-friction bearings and end-bell constructon.

The generating voltage is 2400 v. It was necessary to reduce the engine speed from 750 rpm to 720 rpm and at this speed the engine horsepower output was 1100 hp for continuous operation. After taking into consideration the matter of maintenance, it was decided not to load the engines under normal conditions above 900 hp; accordingly, 750 kva generators with a 40 deg temperature rise on the stator were decided upon. The 40 deg stator temperature rise made possible the use of the full engine output in emergency

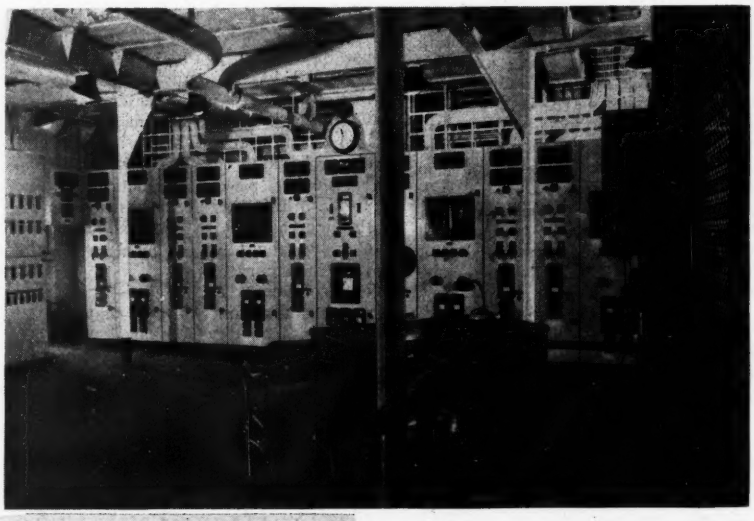


Fig. 1. (Left) The Barge "Electra" ready for service. This view shows the three 2000 kva, single phase, oil insulated transformers mounted on the deck. The barge is 175 ft long, 45 ft wide and 11 ft deep

Fig. 2. (Above) The Main Control Room. The main switchboard consists of 14 panels and a swinging synchronizing panel. Truck type air switches with metal switchgear is installed to facilitate access and quick emergency replacement

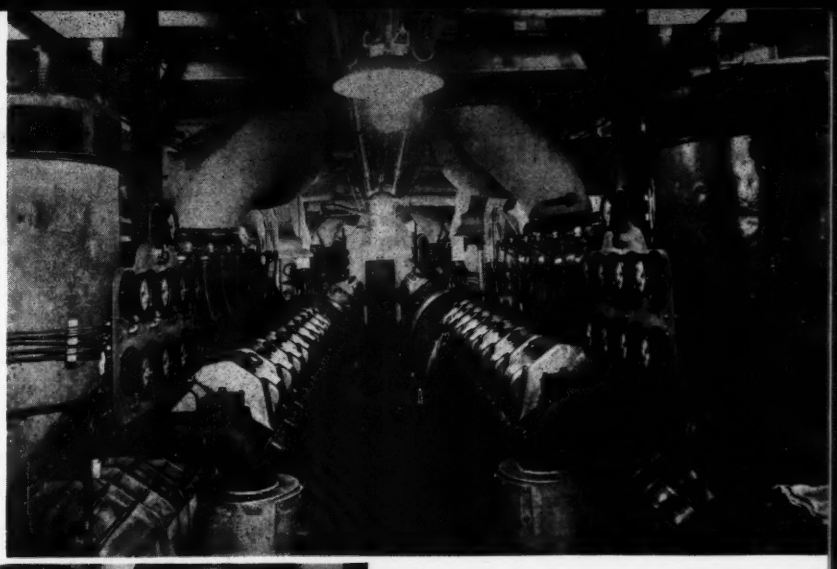
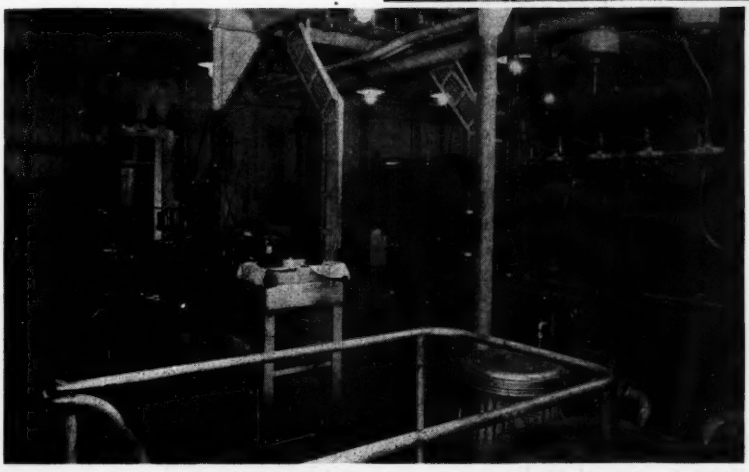


Fig. 3. (Right) A portion of the main engine room showing the engines. Eight 1350 hp, 750 rpm Diesel engines drive the main generators

Fig. 4. (Below) The auxiliary engine room and machine shop. The two auxiliary generating units are for use when the main plant is shut down as in moving from one location to another



and also compensated for the high ambient temperatures which might be encountered in some localities. Each generator was equipped with a direct connected exciter.

Six thermocouple units were placed symmetrically in the stator windings of each generator and the wiring led to the generator switchboard panel to facilitate close check on temperatures. To prevent damage due to high humidity, strip heaters were installed in the main generators and exciters. These heaters were so arranged as to disconnect automatically when the generator was placed on the bus. It was found that eight main generating units of the type described were all that could be crowded into the barge. This section of the plant is called the Main Engine Room.

In order to handle the auxiliary plant load, two 150 kw, three phase, 240 v engine driven generating units were installed. These are for use when the main plant is shut down, as in moving from one location to another. Provision is made to parallel these units with the main generating plant in case of emergency. These units were located in a separate room known as the Auxiliary Engine Room and Machine Shop. The generators for these auxiliary units include the same design features as the main generators, except that no thermocouples were installed, as intermittent use only is contemplated for these units. In this Auxiliary Engine Room are located the lathes, boring mill, etc., for the maintenance of the plant.

Lubricating oil tanks and coolers together with appurtenant pumps are located below each engine, in the bottom of the barge. Additional storage for 5000 gal of lubricating oil, together with centrifuge oil purifier, is located in the forward compartment of the hull. Lubricating oil from any engine may be led directly into the rejected oil tank, passed through the centrifuge to the serviceable oil tank and thence back to the engine crank case.

Fuel storage tanks have a total capacity of 2600 bbl and are built in along the sides of the hull.

Each engine is equipped with the necessary alarms for indicating low lubricating oil pressure, low salt water heat-exchanger pressure, and high cooling water temperature. The system terminates in the switchboard control room where indications of trouble are shown by red pilot lights and further announced by the blowing of sirens both in the control room and in each engine room and by the lighting of a red light directly over the engine concerned.

Truck type air switches with metal switch gear were selected, to facilitate access and permit quick emergency replacement. The main switchboard consists of 14 panels and the necessary swinging synchronizing panel. Generator protection consists solely of a reverse power relay and anti-motoring relay. In view of contemplated service to large motors it was felt that overload protection would complicate operating conditions. In the contemplated use of this plant where 3000 hp and 1000 hp motors must be picked up in the load, it will be necessary to parallel several generators. If one generator left the line because of the tripping of overload relay, it is probable that the entire plant would trip. Therefore, no overload protection is provided and it is expected that the generators and engines will wade into the load to their utmost and ride out such peaks.

The main generator switches for each engine are identical, being rated at 600 amp, 5000 v, with an interrupting capacity of 50,000 kva. They are remote operated from the 120 v, d-c station battery. To facilitate replacement of a switch for inspection or damage, a spare unit is stowed on the necessary truck in space located at the starboard side of the main switchboard. Replacement can be made in ten minutes.

In addition to the main generator control panels, there is a totalizing panel with remote control switch for protection and for the operation of the 12,000 v supply between the high tension side of the main transformers and the submarine cable. This switch is located outdoors and is rated at 400 amp, 15,000 v with an interrupting capacity of 150,000 kva. It is of the oil blast type and is equipped with the usual complement of disconnecting switches. An interlock is provided, so that anyone opening the door to the disconnect cell while the 12,000 v oil switch is closed, would immediately trip the oil switch. The totalizing panel contains the induction type overload relays for tripping the 12,000 v switch, as protection against line faults. This panel also contains the synchronizing facilities for synchronizing the plant

(*Continued on page* 134)

Unloading Fine, Wet Coal With the MATERIAL ACCELERATOR

By

M. L. Whiting

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Details of device that has successfully solved difficult car-unloading problem . . . In one case, increased unloading rate from 100 tph to 200-250 tph with frozen coal and 250-300 tph with unfrozen wet coal . . . Operating results given . . . Improvements in design and construction made as result of two years of operating experience

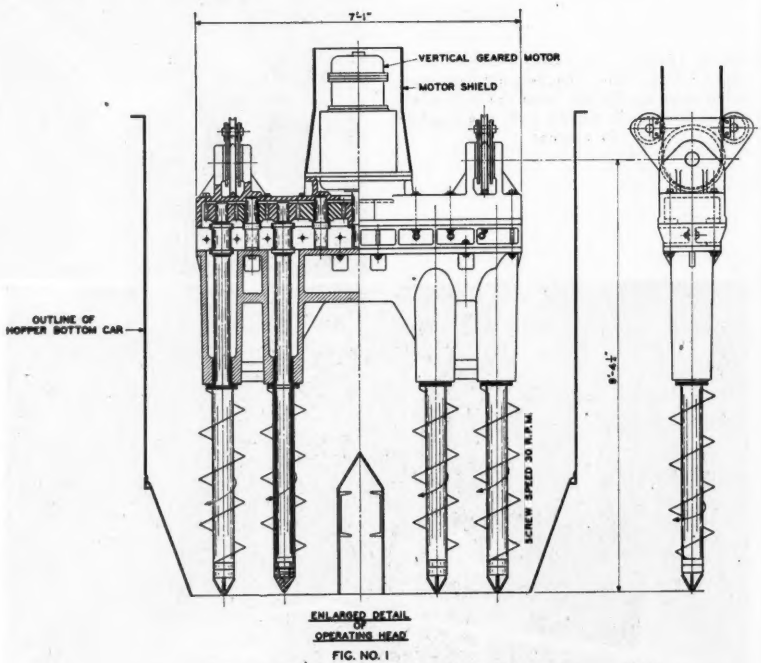


Fig. 1. Details of operating head of material accelerator

A CAR UNLOADER known as a Material Accelerator has recently been developed for aiding in the unloading of coal or similar material. This device successfully handles the difficult problem of unloading fine, wet coal from hopper bottom cars into a track hopper. The second one of these unloaders to be built was installed and put into operation at a central steam generating plant about two years ago.

Considerable interest in this unloader has been displayed by many persons having to do with coal handling problems in connection with industrial and central station generating plants. A number of persons have visited this installation for the purpose of witnessing its operation and many inquiries have been received regarding operating results obtained. The following presents information regarding the construction, operation, maintenance, and operating result of this unloader. It will be of interest to those who are confronted with the problem of unloading wet, fine coal or similar material from hopper bottom cars.

Description of Equipment

In general this equipment consists of the operating head, overhead crane bridge, and carriage.

The operating head, Fig. 1, consists of four vertical 12-in. screws mounted on spindles which extend upwards into the driving head. The screws are driven with a vertical motor through a train of gears running in an oil bath. The motor is mounted on the top of the operating head. A heavy plate shield surrounds the motor to protect same from damage during operation.

The overhead crane bridge provides longitudinal movement of the operating head and overhead carriage provides transverse movement of the operating head. The crane bridge and carriage are made up of structural shapes and plates and each is mounted on four double flange wheels. The bridge is driven with a motor through a reduction gear and squaring shaft and the carriage is driven with a motor through a reduction gear in a fashion similar to that of the conventional overhead electric crane.

The operating head is suspended from the carriage with two 2-part wire ropes and is raised and lowered with the hoisting mechanism mounted on the carriage. The hoisting mechanism consists of a motor, speed reducer, and a pair of spur gears driving the drum shaft, on which is mounted the two hoisting drums. The dead ends of the two-part ropes are attached to vertical counterweights, which keep the operating head in a vertical position when lowering it into the coal. The crane bridge is provided with suitable platforms for convenient servicing of the equipment. Access to platforms is by means of a ladder located in the operator's cage.

The operator's cage is suspended from the bridge directly over the car. All starting equipment and control switches are mounted in the operator's cage. The starting switches are hand operated, oil immersed, reversing type.

Power is supplied to all motors by means of flexible cables. A reel is provided and mounted on the carriage for the flexible cable to the operating head motor, which pays out or takes in the cable as the head is raised or lowered.

Solenoid brakes are provided for the crane bridge, carriage, and hoisting motors.

Figures 2, 3 and 4 show the general arrangement and overall dimensions for the complete installation.

Operating Procedure

When the coal hangs up over the doors of a hopper bottom car after they have been opened, the screws are lowered into the coal directly above the doors until the screws have penetrated the coal to their full depth. The penetration is caused by the screw action and the weight of the operating head, which is about 5 tons. The screws are then reversed, causing the coal to be pushed downward, starting the flow of coal through the doors.

As the coal flows, the operating head is moved slightly backward and forward in a longitudinal direction until all the coal directly above the doors has gone down. The operating head is then raised and moved toward the end of the car, a distance of several feet, where it is again lowered into the coal the full

depth of the screws, at which time the operating head is moved toward the doors, causing the coal to fall through.

This operation is then repeated until the coal is completely removed from that end of the car with the exception of about 1 ft of coal, which must be scraped down with scoops. While the coal is being scraped down, the operating head is moved to the opposite end of the car, where the same operation is repeated.

Basis for Selection of Material Accelerator

The coal handling system for the plant at which this material accelerator was installed was originally designed for a capacity of 200 tph, (tons per hour) or equal to the maximum rate at which free flowing coal can be dumped without an unloader or dumper. At the time of design the installation of an unloader or car dumper was not anticipated at any future time.

Due to plant expansion, the desire to provide for future expansion, and also to the increased use of ⅜ in. screenings, it was decided that the unloading capacity would have to be increased by means of some type of dumper or unloader.

The installation of a dumper would have necessitated the construction of a new track hopper substructure and superstructure, and the installation of additional conveying facilities, the cost of which would have been so great that consideration was given to the possibility of installing some type of unloader that could be installed over the existing hopper with a comparatively small amount of alterations and reinforcement of the existing superstructure.

Investigation of the material accelerator showed that it was entirely feasible to install this equipment over the present hopper, with a comparatively small amount of alterations and at about one-fourth the cost of a dumper and the necessary new construction.

Operating Results

Previous to the time of installation of the material accelerator, the reliable rate of unloading was about 100 tph for fine, wet coal, with four men for switching, opening doors, and cleaning cars. This rate was reduced about 50 per cent when unloading frozen coal, even with double the number of men, and thawing the cars with oil torches previous to unloading.

The use of the material accelerator has increased the reliable rate of unloading to about 250 to 300 tph when unloading unfrozen, wet 1¼ in. nut and slack, or ⅜ in. screenings, depending upon the amount of moisture and size of cars. This capacity is reduced to about 200 to 250 tph when unloading frozen coal that has been thawed with oil torches.

Three men are required for unloading unfrozen coal one operating the material accelerator and two for switching cars, opening doors, and cleaning cars. Six men are required for unloading frozen coal, one for operating the material accelerator, two for thawing cars with oil torches, and three for switching cars, opening doors, and cleaning cars.

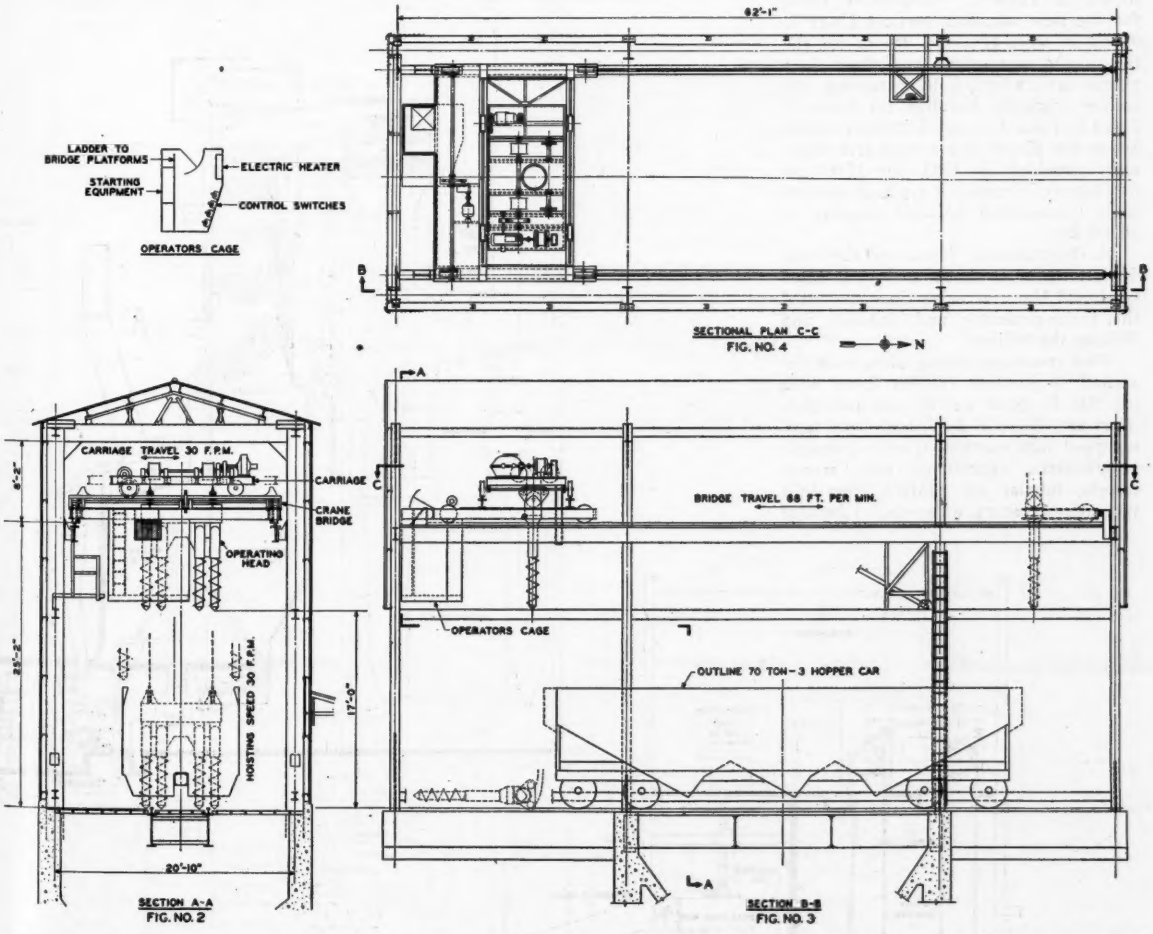
At this particular plant the cars are moved with a car puller, and the track hopper is of sufficient size to allow unloading of car at one standing.

The original capacity of 200 tph for the conveying system is now being increased to 400 tph to handle the increased unloading capacity.

Improvements in Design and Construction

Due to the frequent reversal of the hoisting mechanism and the screws, the impact caused by the operating head hanging up and then being suddenly released, and by the operating head when coming in contact with the sides and ends of the car, the service required of this equipment is extremely severe.

(*Continued on page* 138)



Figs. 2, 3 and 4. Plan and sections of material accelerator, showing general arrangement and overall dimensions for complete installation

Unit 17 At Fisk Station

OUTSTRIPPING in capacity any other turbo-generator placed in service in this country since Pearl Harbor, the new 147,000-kw Unit 17 at Commonwealth Edison Co's historic Fisk Station is now running under full load. It is the largest single-shaft turbine in the world operating at a steam pressure of 1250 psi and a temperature of 925 F.

This latest addition to the Chicago area power pool was installed at Fisk because of the station's proximity to the center of load and the economies made possible there through the replacement of three outmoded, inefficient machines. Adoption of 147,000 kw as the size for the unit was dictated by two factors—the space-saving advantage of its compact design and the estimated additional capacity requirements of the system as a whole. The operating steam pressure and temperature were chosen principally because of their desirability for an economical, modern, straight-through, simple condensing turbine.

The chronological sequence of the units installed at Fisk since the station was first placed in service in 1903 is shown in Table 1. To provide space for the new machine, vertical Units 8, 9 and 10 were removed. Room for the two steam generators and four feed pumps was afforded by removing the boilers originally installed for Units 6, 7 and 8. Thus the new 147,000-kw installation was placed in a station area originally provided, in 1903, for 15,000-kw of capacity. Actually it replaces obsolete units representing installed capacity of 36,000 kw.

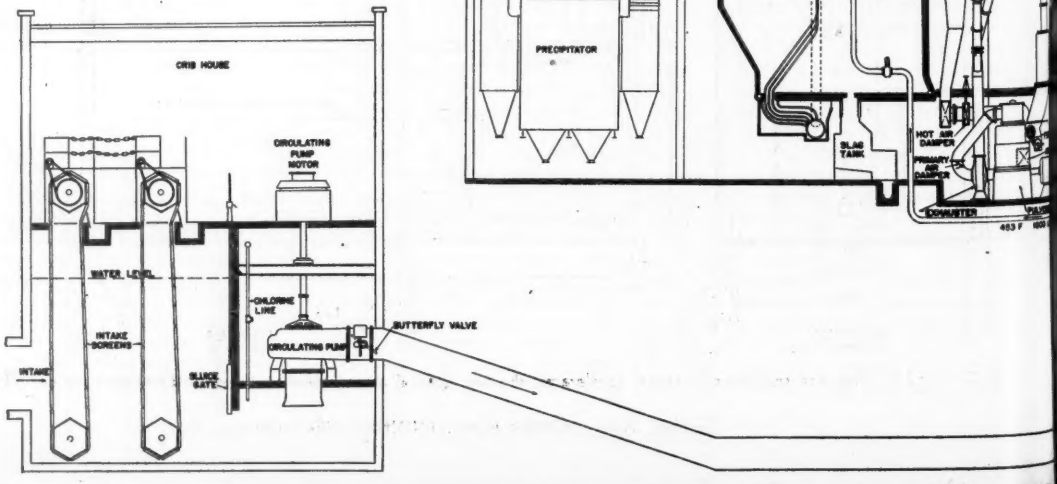
A diagrammatic layout of the Unit 17 installation is shown in Fig. 1. Allis-Chalmers Manufacturing Co. constructed the turbo-generator and Babcock and Wilcox the boilers.

Two steam generating units, each designed to provide 750,000 lb of 1325 psi, 935 F steam per hr. are provided. They are of the B. & W. high head type, equipped with continuous tube drainable superheaters, continuous tube economizers, tubular air heaters, inter-tube type attemperators, water-cooled furnace walls and continuous slag tap furnaces. Relatively low furnace heat release and wide tube spacings in the generator convection banks and superheaters were stipulated to prevent slag fouling. As a result, effective slag removal is attained with the mechanical blower installation which is composed entirely of retractable blowers in the boilers, superheater and economizer sections. The heat absorbing surfaces are arranged to facilitate effective mechanical cleaning.

Particular attention was paid to obtain adequate and effective boiler water circulation. The 25-in. down-comers from each end of the steam drum to the bottom drum provide adequate solid water supply. Provisions for single-circuit, positive circulation have proved adequate since no tube failures have occurred to date. The steam generators had been in service approximately a year before the turbine, furnishing steam to similar pressure equipment in the station and through a pressure-reducing and desuperheating system to low pressure equipment. This preliminary operation demonstrated that the boilers would require very little adjustment and has provided the operating personnel with an opportunity to put into practice the training received in an instruction program completed before the equipment was ready for service.

With the installation of Unit 17, the station coal handling system was modernized. The new plant has a capacity of 800 tons per hr and is considered ample to serve both present and proposed units at Fisk. Normal station coal supply is received by barge, unloaded by a traveling tower crane, crushed to 1¼ in. minus size by two 500-ton-per-hr breakers and transferred to the boiler bunkers by belt conveyors. Alternate coal supply may be received by rail, the cars being unloaded by a rotary car dumper, designed to empty 20 cars per hr.

Coal for Unit 17 is transferred to 1,000-ton bunkers, one for each boiler. From here it flows to three 17.5 ton-per-hr bowl mills and, after pulverization to 70 per cent through 200 mesh screen size, is fed to the furnaces by 12 multi-tip, intertube, pulverized coal burn-



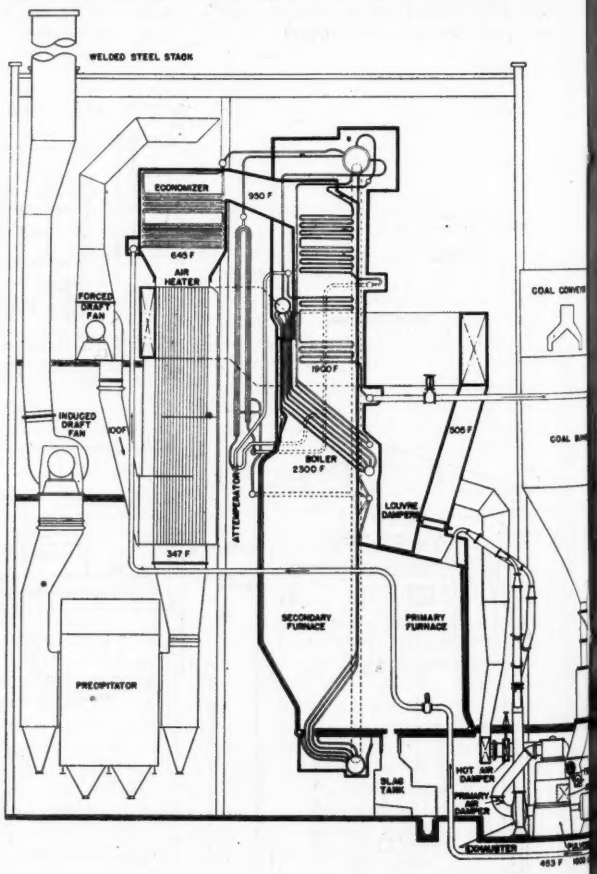


Fig. 2. New Unit 17 at Commonwealth Edison Company's Fisk Station, Chicago. Rated at 147,000 kw, it is the largest turbo-generator to be installed in this country since Pearl Harbor

ers disposed across the top of each primary furnace.

Fuel fired in this installation is Central Illinois coal, which has an ash content of approximately 14 per cent. Electric precipitators, one for each boiler unit, are located in the gas duct between the air heaters and induced draft fans. They collect 90 per cent of the fly ash borne by the gases before they discharge to the stack.

Fly ash collected in the precipitator hoppers is removed periodically by a "hydrovac" dust system. By means of this method, the dust from the 16 hoppers under each precipitator is removed automatically and transported to a vacuum dust collector bin, from which it may be fed continuously to a 500-ton dust storage bin by means of a vacuum sealing dust feeder. The dust from the overhead storage bin is passed through a mixer and unloader (where water is added to produce a commercially dustless mixture) to rail cars for disposal.

Melted ash (furnace slag) flows continuously from the furnace walls through two water-cooled slag holes in each primary furnace floor to two water-filled slag tanks provided for each boiler. It is periodically sluiced from these tanks to an outside ash pit for disposal.

The automatic boiler control system is designed to provide three methods of control—full automatic, boiler manual and hand. Under full automatic control the system is actuated by changes in main steam header pressure through a master pressure element controlling the regulators of both boilers. With boiler

FIG. 1 DIAGRAMMATIC LAYOUT OF UNIT NO. 17 INSTALLATION AT FISK STATION

HIGH PRESSURE TURBO-GENERATOR
MFR.- ALLIS-CHALMERS MFG. CO.
1-147,000 KW, 1800 R.P.M. TURBINE
1250 PSI, 925 F THROTTLE
1" HG. EXHAUST PRESSURE
2 IMPULSE ROWS-39 REACTION STAGES
1-147,000 K.W. DOUBLE WINDING GENERATOR
12800 V., 3 PHASE, 60 CYCLE, 80% P.F.
1800 R.P.M., AIR COOLED

CONDENSING EQUIPMENT
CONDENSER
MFR.-WESTINGHOUSE ELEC. & MFG. CO.
ONE PASS RADIAL FLOW SURFACE TYPE
TUBE SURFACE — 90,000 SQ. FT.
CONDENSATE PUMPS
MFR.-WESTINGHOUSE ELEC. & MFG. CO.
3-1050 G.P.M., 350 PSI, 4 STAGE
STEAM JET AIR PUMPS
MFR.-WESTINGHOUSE ELEC. & MFG. CO.
2-2 ELEMENT, 2 STAGE AIR EVACTORS
CIRCULATING WATER PUMPS
MFR.-WORTHINGTON PUMP & MACH. CORP.
NUMBER OF PUMPS — 2
CAPACITY — 82,500 G.P.M.

HIGH PRESSURE BOILERS
MFR.- BABCOCK & WILCOX COMPANY
2-750,000 LB./HR., 1325 PSI, 935 F
STEAM GENERATORS
EFFECTIVE HEATING SURFACES
BOILER 49,84 SQ. FT.
FURNACE TO SUPHTR. 11300 SQ. FT.
BOILER & WATERWALL
ABOVE SUPHTR ENTRANCE 15304 SQ. FT.
SUPERHEATER 39480 SQ. FT.
ECONOMIZER 26323 SQ. FT.
AIR HEATER 100218 SQ. FT.
ATTEMPERATOR 2964 SQ. FT.
FURNACE VOLUME 116000 CU. FT.
MAX. HEAT RELEASE-19,400 BTU./CU. FT./HR.

PULVERIZED FUEL EQUIPMENT
MFR.- COMBUSTION ENGINEERING COMPANY
6-17.5 TON/HR. RAYMOND BOWL MILLS

FANS
MFR.-B. F. STURTEVANT COMPANY
4-167,000 C.F.M. TURBOVANE INDUCED DRAFT FANS
4-DUAL SPEED MOTORS
HIGH SPEED - 700 H.P., 900 R.P.M., 2300 V.
LOW SPEED - 450 H.P., 720 R.P.M., 2300 V.
4-96,000 C.F.M. TURBOVANE FORCED DRAFT FANS
4-DUAL SPEED MOTORS
HIGH SPEED- 400 HP., 1200 R.P.M., 2300 V.
LOW SPEED- 225 H.P., 900 R.P.M., 2300 V.

ELECTRICAL PRECIPITATORS
MFR.-RESEARCH CORPORATION
2-75 KV., 54 GAS (ADCT COTTRELL PRECIPITATORS
10-25 KVA., 440 V., 75 KV TRANSFORMERS
10-MECHANICAL RECTIFIERS

BOILER FEED PUMPS
MFR.- WORTHINGTON PUMP & MACHINERY CORP.
4-600,000 LBS./HR., 1600 PSI, 350 F PUMPS
3-1750 H.P. 5600 R.P.M. WESTINGHOUSE CONSTANT SPEED MOTORS
1-1540 H.P., 3340 R.P.M. WESTINGHOUSE TURBINE

FEEDWATER HEATING AND EVAPORATING EQUIPMENT
MFR.-GRISCOLM RUSSELL COMPANY
1-4280 SQ. FT. 4 PASS HEATER (NO. 1)
1-3800 SQ. FT. 4 PASS HEATER (NO. 2)
1-3755 SQ. FT. 4 PASS HEATER (NO. 3)
1-4420 SQ. FT. 4 PASS HEATER (NO. 4)
1-5020 SQ. FT. 2 PASS HEATER (NO. 5)
1-1170 SQ. FT. 1 PASS DRAIN COOLER
1-107,260 LB./HR. CO_2 BOILER
1-83.7 SQ. FT. 4 PASS CO_2 BOILER VENT CONDENSER
1-206 SQ. FT. 1 PASS EVAPORATOR HEAT EXCHANGER

PUMPS
MFR.-INGERSOLL-RAND COMPANY
2-100,000 LB./HR., 360 PSI, NO. 1 HEATER DRAIN PUMP
2-80,000 LB./HR., 370 PSI, NO. 2 HEATER DRAIN PUMP
2-125,000 LB./HR., 350 PSI, CO_2 BOILER DRAIN PUMP
2-235,000 LB./HR., 385 PSI, NO. 4 HEATER DRAIN PUMP
2- 60,000 LB./HR., 100 PSI, EVAPORATOR FEED PUMP

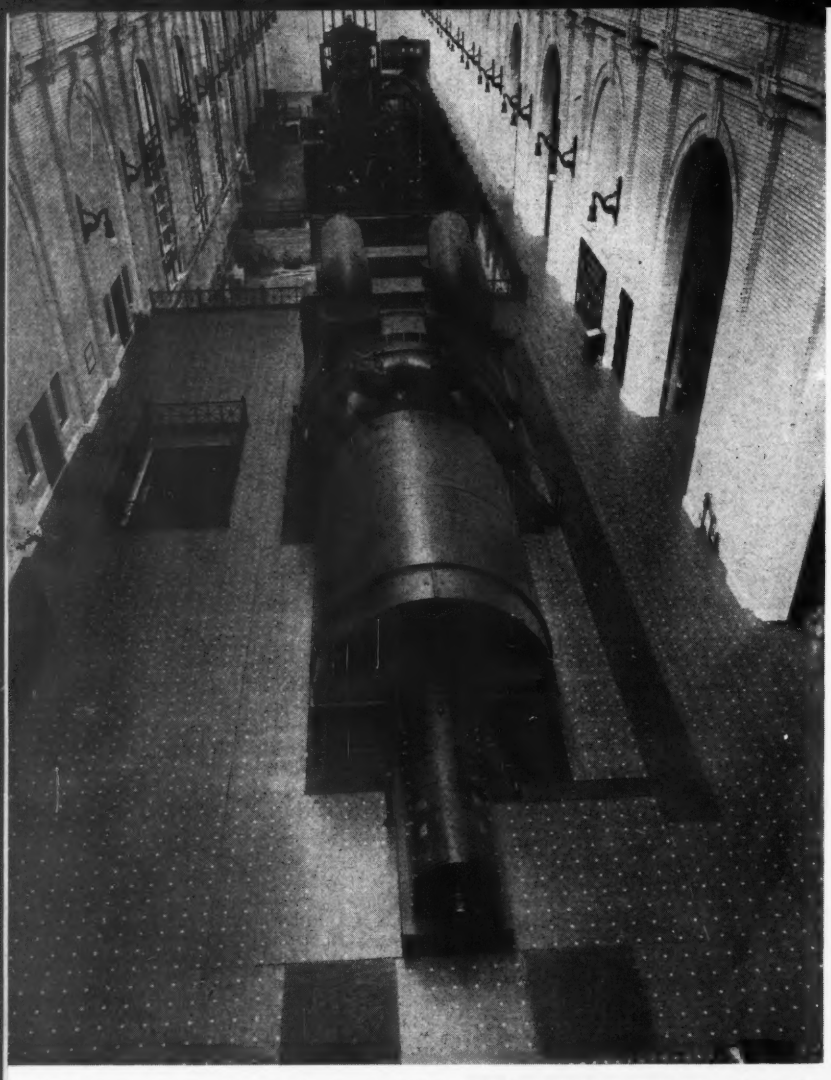


Fig. 3. A view of the turbine room at Fisk Station showing the new 147,000 kw generating unit in the foreground

manual control the regulators of either boiler may be controlled by a single control element. Under hand control the regulators of each boiler may be controlled individually from the boiler board.

Control of the steam passing through and by-passing the attemperator of each boiler is controlled only by a remote hand control unit to regulate final steam temperature. Efforts to attain simplicity in the control system have resulted in a reliable system, although the installation is complicated by the fact that two induced draft fans, two forced draft fans and three sets of mills and feeders per boiler may be operated in various combinations. The control system is arranged to accommodate these operating requirements.

Four 600,000-lb-per-hr, 1600 psi boiler feed pumps are provided for the installation. Three are driven by constant speed 1750-hp, 3570-rpm motors and one by a 1540-hp, 3340-rpm turbine. Feed pressure is controlled manually from the motor-driven pumps by throttling the pump discharge valves. Control with the turbine driven pump is attained by regulating its speed. Normally the turbine driven pump is used as a "spare".

The throttle steam flow at full load is 1,262,000 lb per hr, while the condenser flow is 845,300 lb per hr. The difference of 416,700 lb per hr is bled for feed water heating. In all, five bleed points are provided. Three of these are located in the high-pressure turbine, one at the cross-over connection and one in the low-pressure turbine. Final feed water temperature of 455 F is attained.

Because of the large amount of steam required, the turbine is provided with two steam chests, one on either side of the high-pressure cylinder. On each steam chest is mounted a 14-in. throttle valve and three 12-in. admission valves. An equalizing line connects the two steam chests to equalize flow at high loads. The turbine is designed for four valve points, two to the impulse stage, the third ahead of the reaction blading and the fourth by-passing six reaction stages.

The blade-carrying portion of the high-pressure spindle is machined from a solid single forging. A stub end is shrunk, keyed and bolted at the low-pressure end. The low-pressure spindle consists of a built-up welded assembly of forged steel discs and two forged steel shaft ends. This construction, unique in design, is used to insure a sound structure in the size of spindle involved.

Unit 17 is provided with a 90,000-sq ft welded steel shell, radial-flow, single water pass condenser, equipped with arsenical admiralty tubes. Circulating water is supplied by two 54-in. motor-driven, vertical-shaft propeller pumps, each having a capacity of 82,500 gpm. These are located away from the unit in the station screen house. Three 5-stage, motor-driven, 1050-gpm, condensate pumps deliver condensate at approximately 350 psi pressure through the feedwater heat-

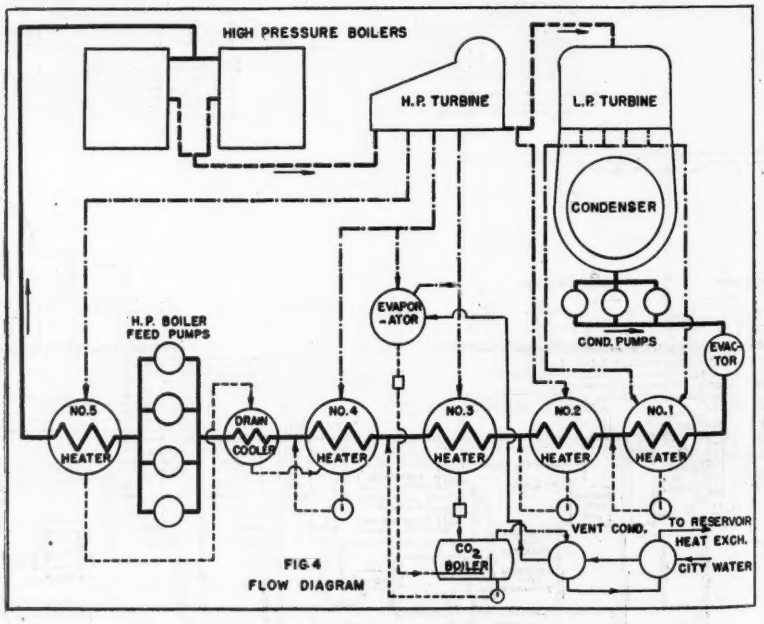


Fig. 4. Flow diagram of the new unit

TABLE I. FISK STATION INSTALLATIONS

Unit	Capacity kw	Service Date	Make	Type	Throttle Steam Conditions: Press ga-lb	Throttle Steam Conditions: Temp. f.	Boilers: Speed rpm	Boilers: No. Per Unit	Boilers: Cap. Each
Old No. 1	5,000	10- 2-03	G.E.	Vertical	200	513	750	8	25,000
Old No. 2	5,000	12-11-03	G.E.	Vertical	200	513	750	8	25,000
Old No. 3	5,000	4-21-04	G.E.	Vertical	200	513	750	8	25,000
Old No. 4	7,500	10-27-04	G.E.	Vertical	200	513	750	8	25,000
No. 5	12,000	9-17-06	G.E.	Vertical	200	513	750	8	25,000
No. 6	12,000	10-10-06	G.E.	Vertical	200	513	750	8	25,000
No. 7	12,000	11-13-06	G.E.	Vertical	200	513	750	8	25,000
No. 8	12,000	1-22-07	G.E.	Vertical	200	513	750	8	25,000
No. 9	12,000	7-19-07	G.E.	Vertical	200	513	750	8	25,000
No. 10	12,000	9-17-07	G.E.	Vertical	200	513	750	8	25,000
Replaced No. 4	12,000	5-21-09	G.E.	Vertical	200	513	750	—	—
Replaced No. 3	12,000	6-14-09	G.E.	Vertical	200	513	750	—	—
Replaced No. 2	12,000	9- 3-09	G.E.	Vertical	200	513	750	—	—
Replaced No. 1	12,000	10-28-09	G.E.	Vertical	200	513	750	—	—
No. 14	20,000	3-30-14	G.E.	Single Cyl.	220	588	1,200	4	90,000
No. 11	25,000	6-21-14	Parsons	Tand.Compd.	220	588	750	4	80,000
No. 13	30,000	12-24-19	G.E.	Single Cyl.	220	588	1,800	4	90,000
No. 12	35,000	1-18-20	West.	Tand.Compd.	220	588	1,500	4	80,000
No. 15	30,000	10- 8-37	A. C.	Single Cyl.	1,200	900	1,500	2	375,000
No. 17	147,000	12-11-43	A. C.	Tand.Compd.	1,250	925	1,800	2	750,000

ing system to the suction of the boiler feed pumps.

Figure 4 shows the flow diagram of the unit. Condensate is pumped from the deaerating storage hotwell at the bottom of the condenser through the feedwater heating system to the boilers. The feedwater heating system consists of five vertical feedwater heaters, a drain cooler, a CO_2 boiler, a vent condenser and a heat exchanger. Condensate from the condenser hotwell is discharged at 350 psi from the hotwell pumps through Nos. 1, 2, 3 and 4 heaters and drain cooler to the suction header of the boiler feed pumps. These pumps discharge at 1,600 psi through the No. 5, or high-pressure heater, to the high-pressure feed heater.

Heaters Nos. 1, 2 and 4 have drain pumps which discharge to the main feedwater line on the discharge side of the heater served. The drain from No. 3, which functions both as an extraction heater and evaporator condenser, passes through a drainer to the CO_2 boiler. A drain pump discharges the flow from the CO_2 boiler to the main feedwater line on the outlet side of No. 3 heater. The drain from the high-pressure heater passes through the coils of the drain cooler and then to the steam space of No. 4 heater.

Condensed steam from the evaporator coils passes through a drainer into the CO_2 boiler where it mixes with the drainage (evaporator distillate) of No. 3 heater. The condensed steam from the evaporator coils, being at a higher temperature than the drainage from the No. 3 heater, causes flashing in the CO_2 boiler, liberating dissolved gases from the make-up before it enters the feedwater stream. The vapor and gases driven off in the CO_2 boiler pass to the vent condenser where the vapor is condensed by the raw water going to the evaporator and the free gases are vented to the atmosphere. The condensed vapor from the CO_2 boiler vent condenser passes to the heat exchanger, giving up heat to the raw water passing through the tubes, and is finally discharged to the reservoir. The amount of raw water evaporated constitutes the required make-up of the cycle.

The generator is a 147,000-kw, 60 cycle, 12,600-v, three-phase, air-cooled unit. It is designed for 85 per cent power factor operation. Because of the machine's large capacity both in kilo-

(*Continued on page* 136)

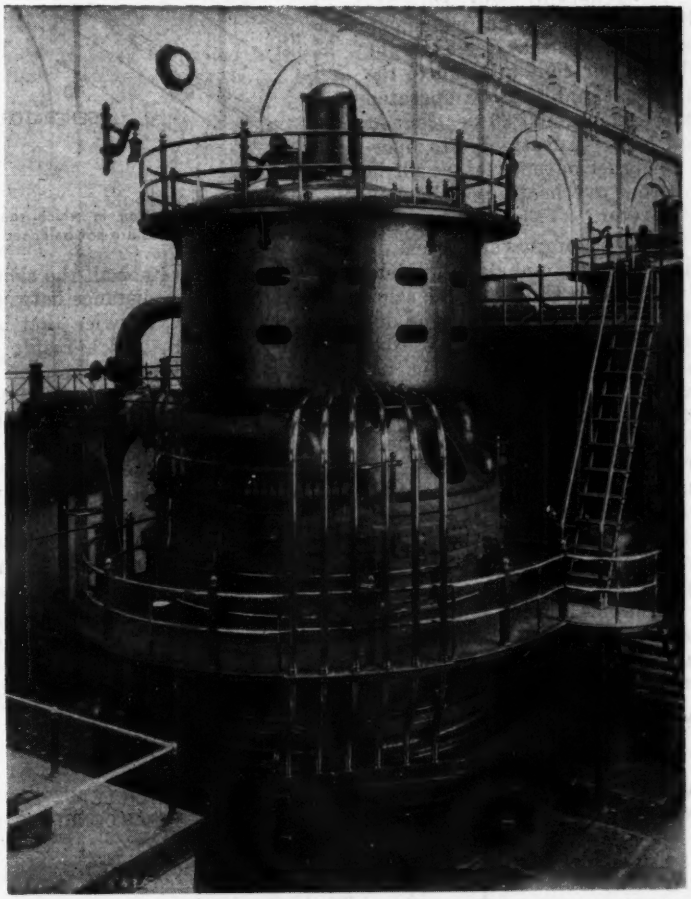


Fig. 5. The first Fisk turbine—"Amazingly large" was the phrase used to describe this pioneer 5000-kw turbo-generator some 40 yr ago when it was placed in operation at Commonwealth Edison Company's Fisk Station. First unit of the country's premier steam-turbine power plant, it marked the dawn of a new era in the electrical industry. Unit 17 has a capacity approximating that of 30 such machines

Current Balancing Reactors For Turbine Generators

Unbalanced phases reduce generator output . . . Unbalance not due to single phase loads but to generator lead arrangement . . . Such unbalances run from five to seven per cent . . . Reduce generator output 25 per cent . . . Remedy is to install reactor in middle phase of each turbine generator

By W. K. BOICE

Industrial Engineering Division, General Electric Co.

SEVERAL industrial plants have recently made use of an unusual expedient to obtain additional output from their existing turbine generators. These generators had been prevented from delivering full output because of unbalances in the phase currents which they supplied. Only a slight unbalance in the current from a turbine generator will substantially reduce the output which can safely be delivered. For example, with five per cent unbalance, the generator should not be operated at more than about 80 per cent of rated load. An attempt to operate at higher output may result in dangerous overheating of the generator rotor.

The type of power system in which current unbalances were encountered is shown in the schematic diagram in Fig. 1. The unbalances were not due to any single-phase loads, since in all cases, the plant load consisted of three-phase motors and a balanced lighting load. The unbalances were found to be due to the construction of the generator leads.

Figure 2 shows the type of generator lead construction used. Each copper bar is of the same length and cross-section, so that the resistance in each phase is the same. The reactances between phases are not balanced, however, because the distances between phases are not all the same. For example, the distance between phases A and C is twice that between A and B. As a result of the unbalanced reactances, more current tends to flow in the middle phase than in either of the other two phases.

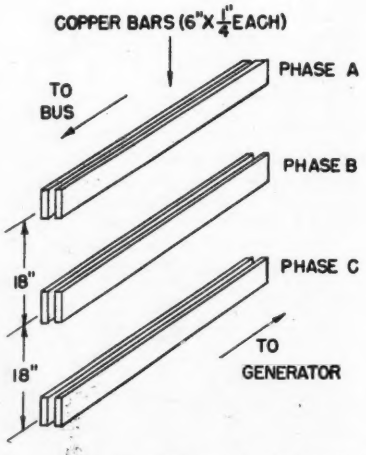


Fig. 2. Lead construction in which reactances between phases are not balanced

In typical phases, unbalances of from five to seven per cent have been observed. Information provided by the generator designer indicated that, with such unbalances, the turbine generators should not be operated at more than about 75 to 80 per cent of rated output. The maximum safe percentage will vary between individual cases, because the maximum load which can safely be carried depends upon the load power factor as well as the amount of unbalance.

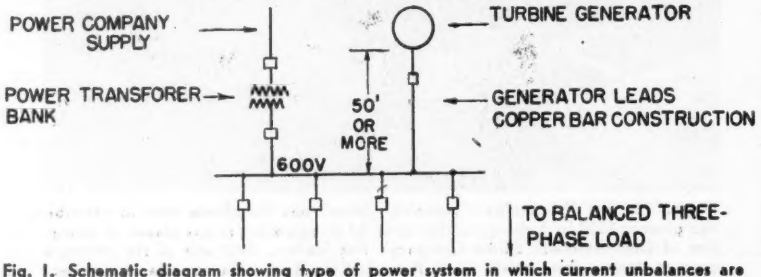


Fig. 1. Schematic diagram showing type of power system in which current unbalances are encountered

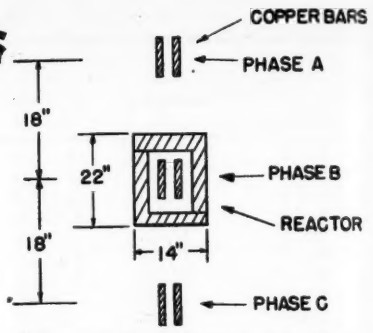


Fig. 3. Application of reactor to bus bar

As illustrated by Fig. 1, many plants receive power both from their generators and from public utility systems. With the generators operating at reduced output, the total power cost was increased because of the relatively greater amount which had to be purchased from the power companies. One textile mill reported that operation of their generator at reduced output because of current unbalances resulted in an operating cost increase of $100 per day. Furthermore, this imposed an additional load on the already overburdened power company's system.

The generators involved have been in the 2000 to 5000 rated kw range. In all cases, they were low-voltage (600 v or less), high-current (2000 amp or more) machines. This fact accentuated the current unbalances since the reactance in the leads of such machines may be quite appreciable (two per cent or more), even for relatively short lengths, say 50 ft. Also, the high current rating of the machines necessitated the use of copper bar construction for the leads which introduced unbalance. Modern practice for power distribution in industrial plants would not involve such low-voltage generators. Generation at a higher voltage (2400 to 13,800 v) and distribution through small transformer banks at the load centers would result in a much more economical and flexible system than the use of low-voltage generators. Such generators are still in use in a number of plants.

When the difficulties due to current unbalances were first encountered, there arose the problem of

(*Continued on page* 120)

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

For the Small Plant Operator

As was pointed out in this column several months ago, some of our readers deplored the fact that we were devoting too much space to articles on large plants. These, they said, were of little value to the small plant engineer. We could argue this point, since it is in the large plant that most new developments originate, and these later are adapted to the use of the small plant. For the moment, however, this is beside the point; what we want to point out here is that we took the suggestions rather seriously and made a definite effort to get more small plant material. During the past four or five months we have run a great deal of "small plant dope" in this section. Notable were the articles "Learning the Hard Way" by R. L. Brown and "Revamping Old Heating System" by Wm. S. White in the July and August issues. We are planning to present other articles in future issues by both of these authors. In this issue, we present two more articles of outstanding interest to the small plant engineer—"Coal and Ash Handling in Small Plants" by Wilbur Hudson, and "Modernizing a Small Factory Power System" by Wm. Gaylord. These are both excellent articles, well worth the attention of every small plant engineer.

We expect to continue this emphasis on the small plants in this section, so if any who read this have material which may be of interest or value to other small plant operators, do not hesitate to send it in. We will give it most favorable consideration.

A.W.K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

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Coal And Ash Handling In The Small Plant

What is the best coal and ash handling arrangement for small power plants? Are such installations made on an economic basis or should they be considered in terms of reliability? What do such small handling systems cost and how are the costs distributed? What capacities are involved? Are suspended, overhead coal bunkers suitable for small plants or are coal bins opposite the boilers more desirable? These, and other similar questions are answered in this article by Mr. Hudson, in a way to enable the small plant operator to analyze his own problems

By WILBUR G. HUDSON

A CORRESPONDENT suggested recently that more attention be given to the small steam plant and this thought was recorded by one of the editors (Mr. Kramer, April issue, Page 91) so this article undertakes the discussion of one angle in the engineering of the small plant—the coal and ash handling equipment. One handicap is that in a plant using a few carloads per month it is not often that any money return on the investment in coal handling equipment can be shown, and of course there is still less chance of showing a return on an investment for an ash disposal system since the tonnage handled is but 10 or 12 per cent of the tonnage of the coal burned. However there are other considerations than the cash return, especially during periods of labor shortage.

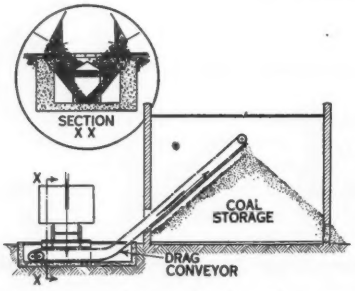


Fig. 1. Car unloading by drag chain conveyor

Many of the older plants receiving coal by rail seem to follow a routine layout of a coal vault opposite the boilers, with small windows through which coal is shovelled from car to vault. If the coal is 1½ in. or smaller, the mechanical arrangement is very simple. A shallow track hopper with a drag chain conveyor (Fig. 1), or a narrow flight conveyor conveying in the lower run with the return run through the track hopper covered by a hood, or a continuous flow type of conveyor, provides for handling capacities up to 30 or 40 tons per hr and forms a pile conveniently placed for shovelling to the furnace or stoker hopper.

In the absence of unloading equipment a local contractor may be given the job of shovelling out the cars as they are delivered, for $12 or $15 per car. It is slow work especially with hopper bottoms, and each car usually ties up the siding for a full day with two shovellers. The cost is about 25 cents per ton unless the coal must also be wheeled, then this cost may be doubled. An unloading conveyor or elevator may or may not show a saving depending on the tonnage, among other factors, and on how the fixed charges are considered. An installation with a capacity of 35 tons per hr may cost around $2000 including foundations, and a plant laborer, as part of his regular duties, will clear a car in about two hours. For 25 cars per year the *total* cost of unloading might be itemized as follows:

Labor	$50
Power and maintenance.....	50
Interest and charge off, 10 yr.	320
Total,	$ 420

per car, or $0.34 per ton.

The labor cost being about four cents per ton.

For one car per week this figure comes down to about 20 cents total cost per ton, or for two cars per week to about 13½ cents per ton, but certainly a plant using two cars per week needs not only mechanical handling but provision for a substantial storage, involving a much higher investment.

Looking back over many small plant installations some come to mind that are quite neat in their design and functioning. Figure 2 shows in cross-section a plant with four small boilers, where stoker coal is dropped from cars to a long storage vault from which it was shovelled to the stoker hoppers. It was desired that the coal in this long vault should be available for any boiler and also to have a record of the weight used by each boiler. A self-feeding, L-path continuous flow conveyor-elevator now extends along the floor, then upward, and is coupled to a short screw conveyor. A 1200-lb capacity weigh larry traverses the line of stoker hoppers. The larry frame has two contactors. One functions to start the conveyors when the emptied larry is pushed back under the screw. The other contactor functions to stop the conveyors when the larry hopper is filled. These are shown diagrammatically in the illustration. The larry is pushed directly by hand. It is un-

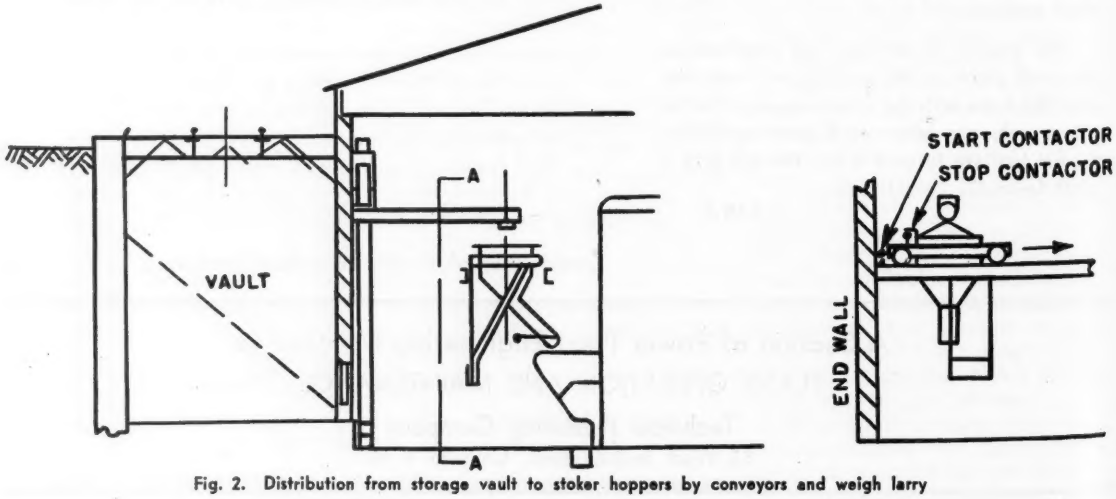


Fig. 2. Distribution from storage vault to stoker hoppers by conveyors and weigh larry

necessary to have either endless chain or motor propulsion when the larry capacity is not over 2000 lb if the track wheels have anti-friction bearings. Only about one-half the vault storage capacity will flow to the conveyor by gravity. The rest is held as a reserve and must be shovelled over if needed. Ashes are handled by a steam jet conveyor.

Figure 3 shows a typical small plant elevator-screw conveyor combination. When coal is thus distributed by a screw conveyor it is necessary either to have an automatic stop which functions when the stoker hoppers are nearly full or, as here, to leave the end of the trough open so the attendant will stop the units when he sees the coal pour out at the end—then he shovels the spillage up into the end hopper. It is better with several stokers to have a continuous flow type distributor which carries out in the top run, distributes from the lower or returning run and sends the surplus back to recirculate. However, a screw conveyor costs about half as much.

Figure 4 is a rather neat installation for automatic transfer of coal from vault to stoker hopper. The vault storage was already taken care of by a flight conveyor from a track hopper beyond the end wall. This is a self-feeding, loop-type continuous flow elevator with 1 hp motor controlled by two Mercoid switches. One is seen near the top of the chute and functions to stop the elevator when the stoker hopper is filled and the coal backs up to that point. The other, not seen, is inside the hopper and starts the elevator when the hopper is about empty.

Figure 5 shows a suspension type bunker with two pairs of outlets, each pair feeding to an automatic scale from which the automatically controlled discharges flow to the feed hoppers of unit pulverizers. This bunker has steel straps suspended from the side girders to support a dovetail, 26 ga crimped steel sheet (Ferro-inclave), and an interior waterproof or gunited sand-cement lining. The cost of this type of bunker will usually be about midway between the cost of a ¼ in. unprotected steel plate bunker and the same bunker with gunite lining. Some of these bunkers have been installed with a width and depth of 30 ft and are in excellent condition after 30 yr service.

The alternative to an overhead bunker is an outside silo with an upper compartment for live storage and lower compartment for reserve storage. Some engineers prefer the silo to the bunker and some do not. For the small plant the concrete silo will cost less than half as much as an overhead bunker of the same total capacity, with supports. If the coal is subject to spontaneous heating from air filtering up through the mass there is the risk of a large and difficult clinker in a silo. With an overhead bunker the coal usually is withdrawn from any heating section and distributed along the line, either by a larry or by a horizontal run-around conveyor. Where the winters are severe the movement of the coal from a silo may be more difficult to maintain than is the flow of warm coal from an inside bunker. However, the investment in an overhead bunker is not often warranted in a small power plant, where a man must be in attendance and might as well have the exercise of shovelling coal at intervals from an adjacent pile. The union allegiance of a fireman may not permit him to wheel coal into the boiler room.

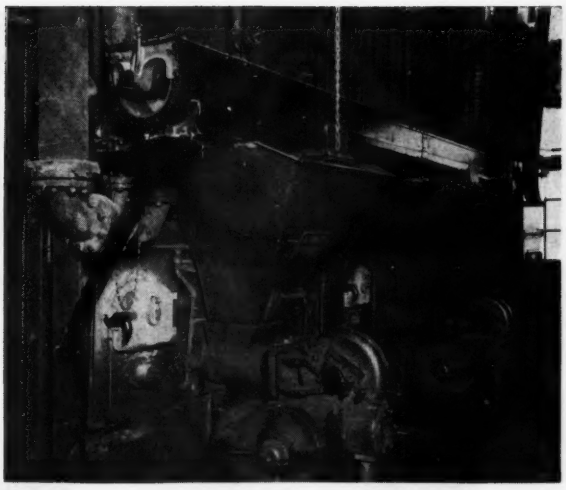


Fig. 3. View in a typical small plant using a small elevator and a screw conveyor for distributing the coal to the stoker hoppers

Considering the disposal of ashes, the installation of an ash elevator may depend on whether the ashes are to be deposited in trucks or merely spread or

"Here comes old 'Well, how is everything going on down here today, boys.' "

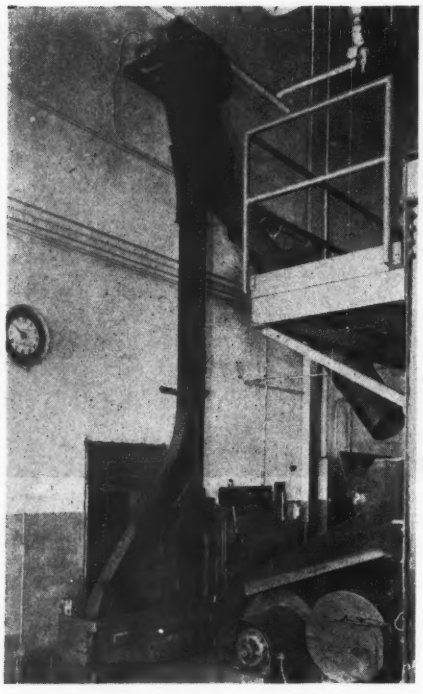


Fig. 4. Automatic elevator

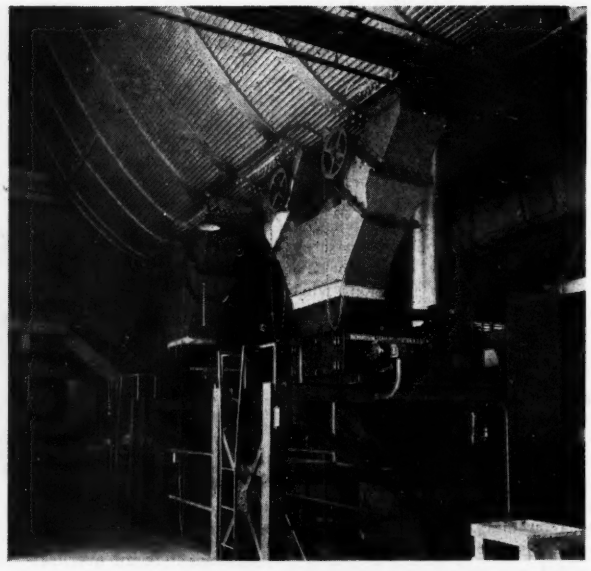


Fig. 5. View in a plant using the suspension type of storage hopper

piled on the ground. It is not advisable to subject the coal elevator to the corrosive and abrasive action of wet ashes. A centrifugal discharge, chain and bucket elevator can if necessary carry on in dual service. A continuous flow type of elevator would be ruined quickly because of its sheet steel casing and embedded chain. A skip hoist has advantages but costs several thousand dollars. There is available, for small capacities and lifts, a simplified semi-automatic ash skip costing about one-fourth as much as the standard skip. This has the skip bucket attached to an endless chain—somewhat like a bucket elevator with only a single bucket—which is raised and lowered by a small motorized reducer. The travel limits are determined by a hatchway limit switch at the top and bottom of the run. For horizontal movement the cast iron screw conveyor with cast iron or concrete trough, is a rugged long-lived machine. Since it cannot change course, as from a basement up to ground level, an alternative is a slow speed drag chain conveyor. Where the requirement is merely to pile the ashes at some point outdoors, and if there is no objection to more or less dust, the ordinary steam jet ejector is cheap and effective, especially if unused steam at the shut-down periods is available for the jet.

Sometimes the plant location is such that the ashes may be flushed out by a slow velocity continuous stream of water in a concrete trench, or by a high velocity water jet in a cast iron trough or duct. At one plant with four, 300 hp boilers equipped with chain grate stokers, where a small crane with grab bucket was already on hand, the ashes from the grates dribbled continuously into a trench where a "brook" about three inches deep was maintained by a centrifugal pump to float the ashes to a self-draining sump. The water was recirculated with sufficient make-up so that it would not too seriously affect the pump. The crane occasionally loaded the ashes from sump to trucks.

In the fortunately located plant where the ashes can be sluiced direct to a settling area, sluicing is the ideal method—low in first cost, in maintenance, operating cost, and completely dustless—but the filtering or drainage of water from the ashes calls for careful study, especially if it may seep into a neighboring stream or the town sewer system.

Practical F. W. Chemistry For Boiler Plant Operators

Here is a short article for operators who would like to have a working knowledge of feedwater chemistry. Most of the articles written on this subject are too advanced for the average man not versed in chemistry. This article by Mr. Wright, assumes little or no knowledge of chemistry and sets forth the fundamentals of the subject in a simple manner

By W. J. WRIGHT

Procter & Gamble Mfg. Co., St. Louis, Mo.

I AM SURE there are a number of operators who would like to have a working knowledge of Feedwater Chemistry, but are unable to understand many of the articles on the subject available at this time. Most of these articles assume that the reader has a fair understanding of simple chemical equations and reactions. Since very few operators know much, if anything about chemistry, it is my hope that I can present the subject in such a manner that they can acquire the fundamental chemistry necessary for an intelligent understanding of the subject.

As a beginning I have prepared a table of commonly occurring elements together with their symbols and atomic weights (approximately). As many as possible of these should be memorized, especially the symbols, so they can readily be recognized when seen. I have also prepared a list of the molecular weights of some of the better known compounds. This list should be kept close at hand in order that the student may become somewhat familiar with them or at least use them for reference.

Name of element	*Symbol*	*Atomic weight*
Aluminum	Al	27
Barium	Ba	137
Calcium	Ca	40
Carbon	C	12
Chlorine	Cl	35

Copper	Cu	64
Hydrogen	H	1
Iron	Fe	56
Magnesium	Mg	24
Nitrogen	N	14
Oxygen	O	16
Phosphorus	P	31
Potassium	K	39
Silicon	Si	28
Silver	Ag	108
Sodium	Na	23
Sulphur	S	32

Frequent use will be found for these elements in the study of feedwater chemistry.

Some of the more common compounds together with their molecular weights are as follows. (A molecule is a combination of atoms.)

Name	*Formula*	*Molecular Wt.*
Aluminum Sulphate	$Al_2(SO_4)_3$	342
Alumina	Al_2O_3	102
Sodium Aluminate	$Na_2Al_2O_4$	164
Barium Chloride	$BaCl_2 2H_2O$	244
Barium Sulphate	$BaSO_4$	233
Calcium Bicarbonate	$Ca(HCO_3)_2$	162
Calcium Carbonate	$CaCO_3$	100
Calcium Chloride	$CaCl_2$	111
Calcium Hydrate	$Ca(OH)_2$	74
Calcium Oxide	CaO	56
Calcium Sulphate	$CaSO_4$	136
Calcium Phosphate	$Ca_3(PO_4)_2$	310
Ferric Oxide	Fe_2O_3	160
Magnesium Oxide	MgO	40
Magnesium Bicarbonate	$Mg(HCO_3)_2$	146
Magnesium Carbonate	$MgCO_3$	84
Magnesium Chloride	$MgCl_2$	95
Magnesium Hydrate	$Mg(OH)_2$	87
Magnesium Phosphate	$Mg_3(PO_4)_2$	263
Magnesium Sulphate	$MgSO_4$	120
Silver Chloride	AgCl	143
Silver Nitrate	$AgNO_3$	170
Sodium Bicarbonate	$NaHCO_3$	84
Sodium Carbonate	Na_2CO_3	106
Sodium Chloride	NaCl	58
Sodium Hydroxide	NaOH	40
Meta Sodium Phosphate	$NaPO_3$	102
Mono Sodium Phosphate	$NaHPO_4$	120
Di Sodium Phosphate	Na_2HPO_4	142
Tri Sodium Phosphate	Na_3PO_4	102
Sodium Sulphate	Na_2SO_4	142

It should be noted that molecular weights are the sums of the atomic weights as they occur in the compound. Example Na(23) + Cl(35) = NaCl (58). Some of these compounds are better known by their common household names.

NaCl	Common Salt
$NaHCO_3$	Baking Soda
Na_2CO_3	Soda Ash
$CaCO_3$	Limestone
$MgSO_4$	Epsom Salts
NaOH	Caustic Soda
CaO	Lime
$Ca(OH)_2$	Slacked or hydrated lime

There are also a number of acids and acid radicals in frequent use. These are as follows:

Bicarbonate	HCO_3	61
Carbonate	CO_3	60
Carbon dioxide	CO_2	44
Chloride	Cl	35
Nitrate	NO_3	62
Phosphate	PO_4	95
Hydrate	OH	17
Sulphate	SO_4	96
Hydrochloric Acid	HCl	36
Nitric Acid	HNO_3	63
Phosphoric Acid	H_3PO_4	98
Sulphuric Acid	H_2SO_4	98

All these terms are in general use.

There are two kinds of hardness in raw water: carbonate (sometimes called temporary) and noncarbonate (permanent). Carbonate hardness consists of the bicarbonates and carbonates of calcium and magnesium. Calcium carbonate is only slightly soluble in water, but the bicarbonate is very soluble and when converted to the carbonate, precipitates out as a white powder. This is the main constituent of the lime found in the hot water pipes in the home. As far as boilers are concerned, carbonate hardness would be fairly simple to handle as it could largely be removed by blowdown, but when in the presence of calcium sulphate it is a different story.

Calcium sulphate occurs in nature in the form of gypsum. Its solubility in water increases with temperature up to 104 F. Then it decreases and at boiler temperature is practically insoluble and precipitates out as a dense hard scale combining with the calcium carbonate and silica (when present) and cements itself to the metal. This is the real culprit, and must be prevented from doing this.

A lot of the carbonate hardness can be removed by boiling in an open feedwater heater. The balance must be removed with lime. The chemical reactions are—

$$Ca(HCO_3)_2 + Heat \rightarrow CaCO_3 + H_2O + CO_2$$
$$Mg(HCO_3)_2 + Heat \rightarrow MgCO_3 + H_2O + CO_2$$
$$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$$
$$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow Mg(OH)_2 + 2CaCO_3 + 2H_2O$$

The $CaCO_3$ and $Mg(OH)_2$ may be removed by sedimentation and filtration. Note that the $MgCO_3$ is not insoluble but has to be converted to the insoluble hydroxide by the addition of more lime. A water containing magnesium in large quantities always requires large amounts of lime to soften.

Calcium sulphate is largely removed by the addition of sodium carbonate

$CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 + Na_2SO_4$

The insoluble $CaCO_3$ being removed again by sedimentation and filtration.

However, to reduce the $CaSO_4$ to too low a figure would require a large excess of Na_2CO_3 and would result in a feedwater that was too alkaline, so the balance has to be removed by internal treatment, usually phosphate.

When meta phosphate is used it first reverts to mono sodium phosphate by picking up a molecule of water.

$$NaPO_3 + H_2O \rightarrow NaH_2PO_4$$

The monosodium then reacts with the sodium hydroxide in the boiler to form trisodium phosphate. $NaH_2PO_4 + 2NaOH \rightarrow Na_3PO_4 + 2H_2O$. (The NaOH is formed by the action of hot water on the Na_2CO_3, by a process called hydrolization. $Na_2CO_3 + H_2O + heat \rightarrow 2NaOH + CO_2$.)

Finally, the trisodium reacts with the calcium sulphate as follows:

$$3CaSO_4 + 2Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 3Na_2SO_4$$

The calcium phosphate is in sludge form and can be removed by blowdown. The sodium sulphate is desirable in limited quantities, its concentration being controlled by blowdown.

In the foregoing I have endeavored to explain the basic reactions taking place in both the feedwater and in the boiler. Now let's examine a sample of raw city water. First we titrate it with an acid solution of known strength against a Pht (phenolphthalein) indicator. By titrate, is meant the addition to one solution of a known volume of another until a desired chemical reaction is attained. We get a phenolphthalein alkalinity or P reading of say 1.0. Let us assume that the acid solution was of such strength and we used a sample of sufficient size to make these readings in grains per gallon. The M.O. (methyl orange) reading is 3.0 and the soap hardness or total hardness is 6.0. The total alkalinity represents the total carbonate hardness. The balance 6.0 — 3.0 = 3.0 represents the non-carbonate hardness. Let's examine this analysis. The P reading represents all the hydrate plus ½ the carbonate, the M.O. represents the total alkalinity. There is no hydrate present as 2A is less than M.O. 2A = 2.0 M.O. = 3.0 then M.O. — 2A = 1.0 which is bicarbonate—probably both calcium and magnesium. The carbonate is probably mostly magnesium as calcium carbonate is only slightly soluble in water. At any rate we add lime to take care of both cases and soda ash to take care of the non-carbonate hardness.

After softening, the P should approximately equal ½ the M.O. reading. If it is less than ½ the M.O., insufficient lime has been added and the bicarbonate form still exists. When P is more than ½ M.O. too much lime has been added, the excess representing caustic alkalinity. When the right amount of soda ash has been used the treated water should carry an excess of say 1.0 to 3.0 after satisfactory hardness reduction has been accomplished, and depending on the boiler alkalinity desired in proportion to the sulphates. A typical treated water may read about as follows:

P = 1.7 M.O. = 3.4 H = 1.0. Thus 2P = M.O. 2(MO-P) — H = 2.4 excess soda ash.

In most cases the sulphate content of the boiler water is in direct and fairly constant relationship to the total solids. In operating below 250 lb pressure a total solids content of 3500 ppm or less, is recommended. Say the average ratio of the total solids to the sulphates is 3 to 1, then the permissible sulphate content would be a little less than 1200 ppm. It should be maintained as near this figure as possible by adjustment of the residual hardness in the feedwater and by blowdown. If the sulphate in the boiler water is too low,

reduce excess soda ash so as to permit a higher residual hardness in the feedwater as well as a lower alkalinity. Then more phosphate will be required to handle the additional calcium sulphate, with the resultant increase of sodium sulphate. If the sulphate reading is too high the soda ash can be increased, resulting in higher alkalinity, lower residual hardness, and less phosphate required. Less sulphate will be in the boiler water as it can be removed by blowdown without too low a reduction in alkalinity.

An excess of at least 30 ppm phosphate as PO_4 is generally recommended to be kept in the boiler at all times to assure complete conversion of the residual hardness to $Ca_3(PO_4)_2$.

You will recall that you are supposed to maintain a 2 to 1 sulphate-carbonate ratio in the boiler. How do you figure this out? Probably your alkalinity is shown in grains per gallon of caustic alkalinity in terms of $CaCO_3$. Your sulphate is shown as SO_4 in parts per million. (This is an actual case and not exaggerated, as one well known consultant has reports in this form.) The boiler code wants this ratio to be reported as Na_2SO_4 against Na_2CO_3 so some figuring must be done. (The Na_2CO_3 as total alkalinity.)

First, the caustic alkalinity represents about 80 per cent of the total alkalinity, so suppose we have a reading of 24 gpg as caustic alkalinity in terms of $CaCO_3$. 24 divided by 80 per cent = 30 gpg total alkalinity, but still in gpg and as $CaCO_3$. Then $30 \times 17.1 = 513$ ppm as $CaCO_3$. $CaCO_3$ has a molecular weight of 100 and Na_2CO_3 has a molecular weight 106, so $1.06 \times 513 = 544$ ppm total alkalinity as Na_2CO_3.

SO_4 has a molecular weight of 96. That of Na_2SO_4 is 142. 142 divided by 96 = 1.48. Say our SO_4 was 1100 ppm. Then $1100 \times 1.48 = 1628$ ppm as Na_2SO_4. $\frac{1628}{544} = 3$ to 1 (nearly) ratio which is more than sufficient.

Most consultants work out a simple formula in place of this but it is well to know how it is actually derived.

In this discussion I have tried to explain the working of a hot process lime-soda softener and the use of the effluent in a steam plant of moderate size and pressure using a large percentage of make-up water. When there are large amounts of condensate return, other problems enter into the picture, notably corrosion. This will not be discussed at this time.

FOR THE PLANT ELECTRICIAN

Wire Tables and Impedance Calculated by Means of Slide Rule

By PVT. ROBERT F. LATTER

IT IS POSSIBLE to duplicate almost the entire B & S wire table, as found in most electrical engineering textbooks, with a slide rule simply by remembering a few simple settings. One hundred per cent accuracy is not claimed for the methods shown here, but the results are within a few per cent and are sufficiently accurate for most engineering purposes. A slide rule is often available where wire tables are not. These solutions arise from the fact that the wire diameter and cross-sectional area change in geometric progression for consecutive gage numbers. The scale nomenclature follows that used on Keuffel and Esser slide rules.

To find the resistance of 1000 ft of annealed copper wire of gage N at 25 C, set either index of the C scale opposite 10.2 on the LL3 scale. Opposite the gage number N on C read ten times the resistance on LL3 or LL2. Note that 10.2 is exactly ten times the resistance of No. 10 wire at 25 C. To find the resistance of wire at other temperatures, a very close approximation is that the resistance increases 4 per cent for each 10 C temperature rise.

This resistance formula can be expressed as

$$R = 1.02^{\frac{N}{10}} \times 10^{\frac{N}{10}-1}$$

where R is the resistance per 1000 ft of the wire size desired at 25 C, and N is the gage number. If the resistances of other conductors besides annealed copper are to be calculated, it is only necessary to divide R by the proper conductivity factor. An easier to remember though somewhat less accurate formula is that

$$R_{20C.} = 10^{\frac{N}{10}-1} \text{ (approx.)}$$

Example: Find the resistance of 1000 ft of No. 20 B & S wire. (A) At 25 C. (B) At 45 C.

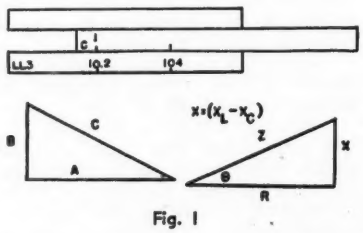


Fig. 1

Solution: See Fig. 1. Set the left index of C opposite 10.2 on LL3. Opposite 20 on C read 104 on LL3. 104/10 equals 10.4 ohms. (answer A.) This is in exact agreement with the wire tables.

To find the resistance at 45 C, increase answer A by 8 per cent. 45 C − 25 C = 20 C, which, as discussed above, corresponds to an 8 per cent increase in resistance. $10.4 \times 1.08 = 11.23$ ohms (answer B).

To find the diameter in mils, set 2 on C opposite 10 on LL3. Calling the gage number N, opposite (50 − N) on C, find the diameter on LL3.[1]

$$D = 10^{\frac{50-N}{20}}$$

The cross sectional area in circular mils can be found by setting the C index opposite 10 on LL3. Opposite (50 − N) on C read the cross sectional area on LL3.[1]

$$A = 10^{\frac{50-N}{10}}$$

expressed as a formula. To convert to square mils, multiply by $\frac{\pi}{4}$ or 0.7854.

To find the weight in pounds per 1000 ft, set the C index opposite 10 on the LL3 scale. Opposite (25 − N) on the C scale, read the weight on the LL3 scale.

$$W = 10^{\frac{25-N}{10}}$$

For wire sizes not covered by this formula, multiply circular mils by 0.00302.

Example: Find for No. 14 B & S wire. (A) Diameter in mils. (B) Cross sectional area in circular mils. (C) Weight per 1000 ft.

Solution (A): Set 2 on C opposite 10 on LL3. Opposite 36 (50 − 14) on C read 64 mils on LL3.

Solution (B): Set 1 on C opposite 10 on LL3. Opposite 36 on C read 4000 circular mils on LL3.

Solution (C): Set 1 on C opposite 10 on LL3. Opposite 11 (25 − 14) on C read 12.6 pounds on LL3.

A little known method for calculating the third side of a right triangle or for impedance calculations and which can be used even on elementary slide rules is derived as follows:

$$C = \sqrt{A^2 + B^2}$$

$$C = B\sqrt{\frac{A^2 + B^2}{B^2}}$$

$$1.\quad C = B\sqrt{\left(\frac{A}{B}\right)^2 + 1}$$

following the same procedure

$$2.\quad B = A\sqrt{\left(\frac{C}{A}\right)^2 - 1}$$

$$3.\quad A = B\sqrt{\left(\frac{C}{B}\right)^2 - 1}$$

For impedance calculations, 1, 2, and 3 become

$$4.\quad Z = X\sqrt{\left(\frac{R}{X}\right)^2 + 1}$$

$$5.\quad X = R\sqrt{\left(\frac{Z}{R}\right)^2 - 1}$$

[1] See "Slide Rule Short Cuts" in the January, 1944 issue of "Radio", page 42.

6. $$R = X\sqrt{\left(\frac{Z}{X}\right)^2 - 1}$$

where Z, R, and X are the impedance, resistance, and reactance of the circuit expressed in ohms. Notice the similarity between equations 2 and 3 and 5 and 6. All six of these equations can be easily solved using only the A, C, and D scales.

The method of solution can best be illustrated by an actual example as follows: Find the absolute (numerical) value of the impedance Z of a circuit where R equals 4 ohms and X equals 3 ohms. See Fig. 2.

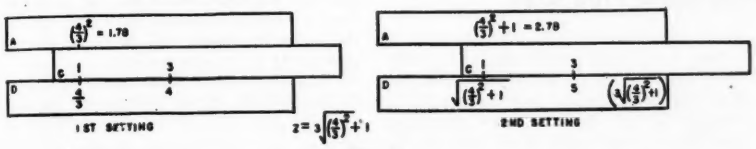


Fig. 2

Solution: Follow formula 4. Set 3 on C opposite 4 on D. Opposite the C index read 1.78 on A. Add 1 to this and reset the C index opposite 2.78 on A. (Second setting.) Opposite 3 on C read 5 ohms on D.

The other formulae are followed in the same manner except that Y, Z, and R are interchanged, and in the second setting, 1 is subtracted instead of added.

If the angle between Z and R is desired, it is necessary to use additional scales—either S or T.

$$\theta = \tan^{-1}\frac{X}{R}$$

$$= \sin^{-1}\frac{X}{Z}$$

Better yet, if a log log duplex trig or similar rule is available, use the well known sine-tangent method described in the Keuffel and Esser instruction books.

However, when only absolute values are required as is often the case, the above method has the advantage of simplicity and the fact that it can be used on almost any slide rule.

PRACTICAL HINTS AND KINKS

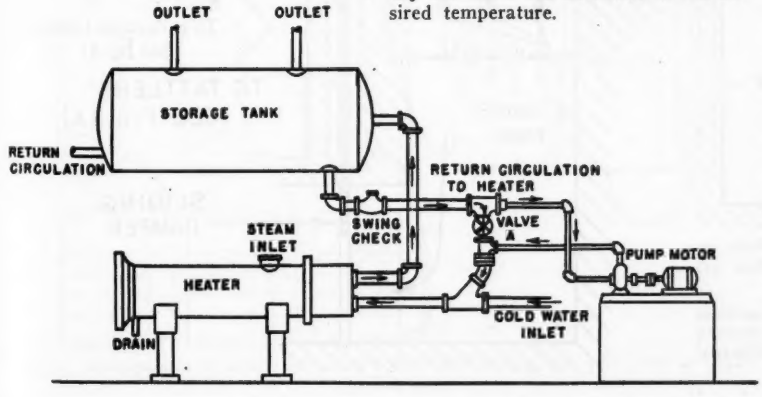
Centrifugal Pump Aids Water Heater Circulation

By G. H. Kimball

IN OUR PLANT we have a 250 gal tank for storage of hot water for general use in the different buildings. By looking at the accompanying sketch it will be seen that the down-flow pipe from the bottom of the tank has a swing check valve on it. This is to prevent a back flow of cold water to the bottom of the tank.

For some time it appeared that there was very slow circulation through this pipe and it often occurred that the tank water would not heat unless the demands on it pulled all of the cold water out and then the incoming supply of hot water filled the tank. It was, therefore, evident that the thermo-syphonic circulation was not powerful enough to lift the disk in the check valve.

The suggestion being made that some sort of a circulator might remedy the situation, a spare centrifugal pump complete with motor was available and this was connected as shown. One-inch pipes were run to the pump, although the regular connections to the tank were two inch. When the connections were made as shown with the valve "A" that could be closed when the pump was running and opened at other times, by operating the pump about 15 min at the beginning of the day the water can be raised to the desired temperature.



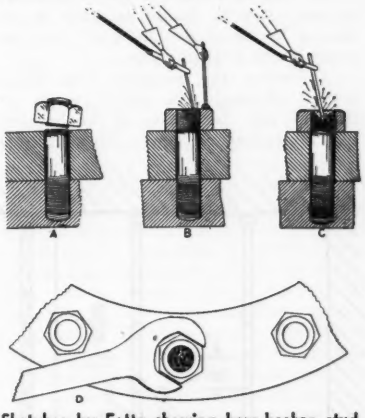
Removing a Broken Stud

By Anthony A. Fette

THE SUGGESTIONS for repairing a broken anchor bolt on page 102 of the April issue were of considerable interest to me and reminded me of an incident which happened several years ago in the brewery plant of which I had charge. In that plant we had a 150-ton, steam-driven ammonia compressor. The machine had been erected over a double-deck basement, the footing was not as rigid as it should have been, and there was considerable draw on the stud bolts holding the cylinder to the bed frame. This resulted in these stud bolts breaking from time to time.

These 24 stud bolts were each 1⅜ in. in diameter by 10 in. long and when one or more broke, the machine had to be shut down and the broken studs replaced, usually a difficult operation. I recall one being so tight that it took several mechanics several days to remove it.

After several of those incidents, one of the mechanics offered a suggestion of tacking a rod onto a nut for holding the nut over the broken stud, then arc welding the nut onto the broken end of the stud and finally removing the stud with an open-end wrench. The method worked out so well that a broken stud could be removed in a very short time and the mechanic was complimented for the idea. It is illustrated by the accompanying sketches.



Sketches by Fette showing how broken stud was removed. A—Broken stud. B—Rod tacked to nut to hold it while beginning weld. C—Welding nut to broken stud. D—Removing stud

After seeing how it saved so much time and strenuous labor, I immediately made my way to the general manager's office, where I requested a ten-cent-per hour increase for that mechanic, which was granted without a moment's hesitation.

After having broken several studs as above, we finally secured heat treated axle steel studs with a tensile strength of 135,000 psi, which held considerably better. But the situation was not entirely remedied until we braced the steam cylinder, after which no more stud bolts broke.

The Boiler Fireman's Handbook

By J. R. DARNELL

Importance of correct sampling of flue gas . . . Procedure in taking sample . . . Equipment needed in taking sample . . . Orsat manipulation . . . Use of check readings . . . Coloring water in measuring burette to make reading easier . . . Preparation of absorption solutions

III. Sampling and Analyzing Flue Gas

WHEN TAKING samples of any gas, particularly furnace gas or flue gas, extreme care must be taken to assure a representative sample. A nationally known combustion engineer once remarked that "any d—— fool can analyze flue gas but it takes a good man to get a real sample." Although not literally true, this statement is indicative of the relative importance of the two operations.

Correct sampling is much more important than the analysis, since if the sample is not properly taken, the analysis is worthless. The operator must be willing to exert himself by drilling holes in steel or brick work and he must have enough curiosity to satisfy himself that he is getting results by diligent exploration. Whether the CO_2 is higher or lower than expected, a check analysis of every sample should be made in order to be satisfied that there was no error in the first analysis.

Inserting the sampler into holes drilled through the brick work or through the steel plate of the breeching, depending on where the sample is taken, generally gives better results than attempting to insert the sampler into an observation opening with a hinged lid or door. These openings usually leave so much space around the sampler that considerable error may result from air infiltration unless the opening around the sampler is properly sealed. Where the hole is drilled through brick work or steel plate it can be made just slightly larger than the sample pipe. This will permit caulking with asbestos rope in such a way that the sampler can be moved in or out with no infiltration of air.

If the sample is taken at a point near the damper, just back of the last row of tubes, care must be taken to guard against false readings due to air infiltration around the damper shaft or from leakage around the boiler drum. Before attempting to judge the efficiency of any fuel burning equipment by reference to flue gas analysis, the investigator must be satisfied that whatever percentage of excess air his analysis shows, is a true reflection of the excess air actually supplied with the fuel and not air that found its way into the setting through leaks. The candle test should be used on all suspicious looking cracks in the setting.

To obtain a representative sample, the investigator must either take a number of grab samples at different points in a horizontal plane in the outlet duct, uptake or downtake just beyond the boiler tubes, or he must provide a sampling manifold. If there is a tendency to stratification, with a definitely lower CO_2 value in a certain area, grab samples should be taken simultaneously in areas of low and high CO_2. Samples may vary from a few cubic inches to one-half to three-quarters of a cubic foot. Grab samples may be taken through the open end of ⅛ or ¼ in. pipe or ¼ in. copper tubing.

Samples taken during a regular boiler test of 24 hr or longer should be obtained through a manifold or a series of perforated pipes, evenly spaced in the uptake, or downtake, just ahead of the damper. Figure 1 is a plan view of an arrangement of perforated sampling pipes forming three separate manifolds, each connected to separate sample lines which connect to a common manifold. Aspiration (suction) is effected by means of a steam syphon as shown by Fig. 2.

In order to be certain that the steam syphon is functioning properly at all times and that the sampling lines are not plugged up, each sampling line should be provided with a Tee connection just ahead of the sample collecting bottle. To each of these connections should be attached a tattler as shown by Fig. 2A. Water in the tattler should be carried at a depth of about 2 in.

Figure 3 shows the sample collecting bottles (½ gal) a, b, and c, which are connected to pipes a, b, and c, re-

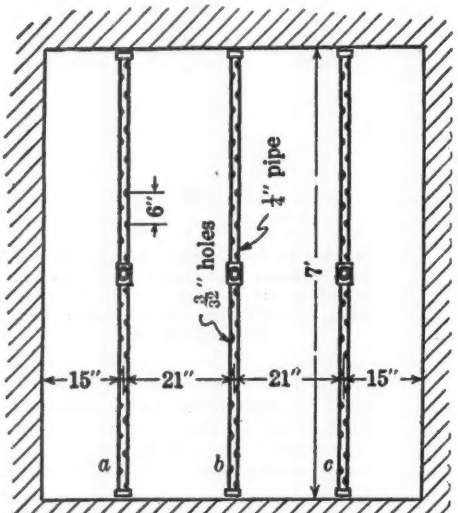


Fig. 1. (Above) Plan view of sampling manifolds arranged to obtain representative samples of flue gas

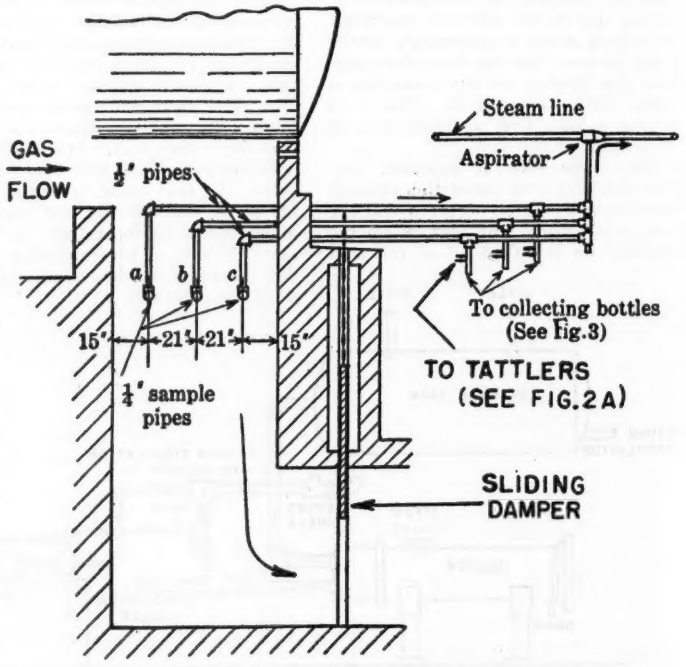


Fig. 2. (Right) Side elevation of sampling manifolds shown in Fig. 1, together with piping to collecting bottles and steam syphon for continuous withdrawal of flue gas samples

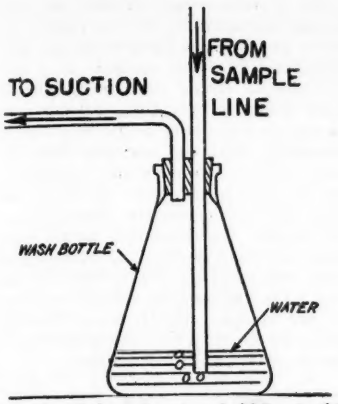


Fig. 2A. If the water stops bubbling in this tattler, the sample line is plugged up or steam to the syphon has been cut off

spectively. Bottle d may be used to collect an average sample from a, b, and c. Each bottle is connected to a leveling can by which the water, over which the gas samples are taken, may be raised or lowered.

In a number of cases, the sampling pipes shown in Fig. 1 may be connected together inside the flue by means of a common header of 1 in. pipe. This header then may be connected to a single line of ½ in. pipe leading to a steam syphon. The gas may be collected in a single bottle similar to those shown in Fig. 3.

Whether single or multiple samples are taken, the flow of water from the bottle to the leveling can must be regulated so that the water in the bottle will flow out into the leveling can at a uniform rate over a given period of time—say, at intervals of 15 min. This can be effected most satisfactorily by means of a screw clamp on the rubber hose connecting the bottle with the leveling can. Such a clamp is shown in Fig. 4.

Figure 5 is a side elevation of any one of the four absorption pipettes used in the Orsat shown in Fig. 3. In the operation of the Orsat, the first pipette nearest the measuring burette contains a solution of caustic potash or soda for absorption of CO_2, the second an alkaline solution of pyrogallic acid for absorption of O_2, the third an ammoniacal solution of cuprous chloride for CO. The fourth may be used as a spare or the two middle pipettes may be provided with the alkaline pyrogallate solution.

Rubber bags of the type shown in Fig. 5 are necessary to protect the pyrogallic acid and cuprous chloride solutions from deterioration caused by the oxygen in the air. No bag is needed for the caustic potash or soda solutions used in the first pipette for absorption of CO_2. Certain modified designs of Orsat apparatus are provided with extra pipettes containing water and connected to the absorption pipettes as shown in Fig. 6. U-bends of large size glass tubing also may be used as water seals.

Flue gas taken as grab samples, through a piece of open end pipe or tubing, should be aspirated by means of a single collecting bottle and leveling can. This bottle should be provided with a three-way cock, either of glass or brass so that the sample can be first drawn into the bottle and then discharged to the Orsat. When first starting to draw the sample, all air in the sample pipe and connecting tubing must be drawn into the bottle and then discharged to the open air before the gas sampling is started. Two or three bottlefuls should be collected and discharged before the operator can be sure that the sample is not contaminated with air. A certain manufacturer of a modified type of Orsat or gas analyzer, furnishes a rubber bulb with an inlet and outlet valve for aspirating the sampling line. These bulbs may work satisfactorily for a time but more often than not, their operation is uncertain and the operator is never sure that the line has been completely aspirated from one sample to the next. On the other hand, the collecting bottle may be used to take a sample as fast as the water will run out or the flow may be regulated for any given period of time.

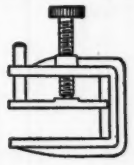


Fig. 4. Screw clamp to be applied to the rubber hose between sample collecting bottle and leveling can in order to regulate water flow when taking time samples

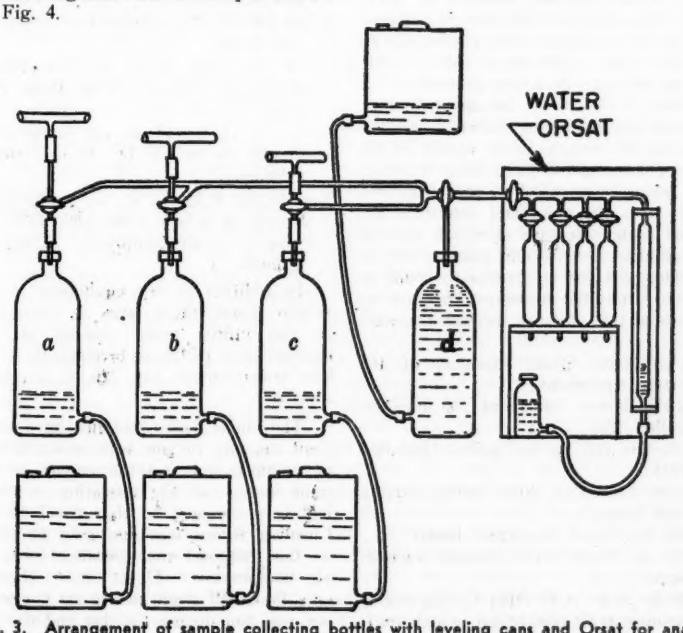


Fig. 3. Arrangement of sample collecting bottles with leveling cans and Orsat for analyzing flue gas

Orsat Manipulation

After a definite volume of gas, preferably 100 cc, has been measured in the burette, the leveling bottle attached to the burette (see Fig. 3) should be raised to a height somewhat greater than the liquid level in the capillary tubing between the top of the pipettes and the stop cocks. Then, holding the leveling bottle in this position, open the stop cock on the first pipette containing the caustic potash solution, thus forcing the solution downward. This downward flow should continue until the water in the burette, rising upward, forces all the gas in the burette into the absorption pipette. Then slowly lower the leveling bottle until the caustic solution just starts to enter the capillary tubing. Be careful, however, that a sudden movement of the hand doesn't cause the caustic solution to shoot upward in the capillary tubing beyond the glass stop cock. If it does, the caustic will get into the glass header above the pipettes and contaminate the next sample. After 5 or 6 up and down movements of the leveling bottle, slowly bring the caustic solution up into the capillary tubing just below the stop cock. Then close the stop cock and measure the gas in the burette by holding the water in the leveling bottle level with that in the burette. Record the amount and then repeat the operation of passing the gas back and forth into the absorption pipette. If the next reading of the level in the burette is the same, it indicates that all the CO_2 in the gas sample has been absorbed.

Check readings should always be made because if all the CO_2 is not absorbed in the first pipette, not only will the recorded reading for CO_2 be too low but the unabsorbed CO_2 will be absorbed by the pyrogallic acid solution and be improperly recorded as O_2. In like manner, if a check reading is not made for the oxygen absorption, the unabsorbed oxygen will be absorbed by the cuprous chloride solution and, therefore, improperly recorded as CO.

The water level in the measuring burette can be read much more readily

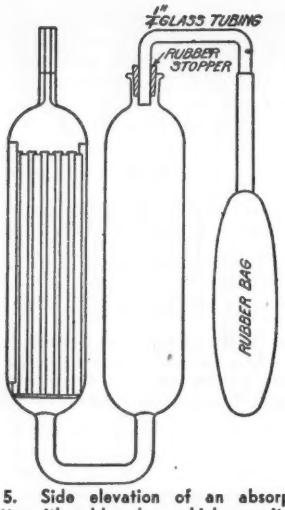


Fig. 5. Side elevation of an absorption pipette with rubber bag which permits expansion and prevents deterioration of absorption chemical

if it is colored red with acidified methyl orange. Methyl orange is an orange colored powder which when dissolved in water may be used as an indicator for acids and alkalies. An amount which can be held on the point of a pocket knife is sufficient to color the water in the leveling bottle and burette. The powder will color the water yellow. Then add a few drops of hydrochloric acid and stir. The acid will turn the water a pinkish-red color which will serve a double purpose. Not only will the reading of the level in the burette be made easier but if any caustic solution should be inadvertently drawn up into the glass header, it can be detected when the water in the burette is forced into the header, preparatory to taking in a new

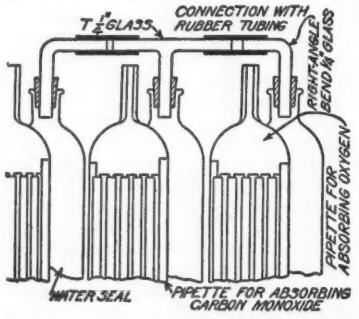


Fig. 6. Side elevation of three absorption pipettes each connected to an extra pipette containing water to seal against contamination from the air

sample. If there is any caustic in the header, the red color of the water will turn to yellow. If this happens, sufficient water from the burette should be passed through the header until the red color persists.

Preparing Absorption Solutions

To obtain the best results the operator should prepare his own solutions which when not being used, should be kept in air tight bottles, preferably those with patented stoppers such as found on magnesium citrate bottles. Solutions may be prepared as follows: For CO_2: potassium or sodium hydroxide, 660 g dissolved in 2000 cc of water. For O_2: solution (A)—potassium or sodium hydroxide, 3600 g dissolved in 2400 cc of water; solution (B)—pyrogallic acid, 150 g dissolved in 4500 cc of water. After (A) has cooled, slowly pour into (B) and exclude air at once. For CO: ammonium chloride, 500 g; cuprous chloride (Cu_2Cl_2), 400 g; dissolve both in 1500 cc of water. Shake thoroughly, let settle and decant the clear liquid. To the latter, slowly add, while stirring, liquid ammonia (Sp. Gv. .90), until a deep blue color just persists. Exclude air at once.

In a subsequent chapter we will discuss the meaning of the values obtained in analyzing samples of flue gas. For example, if an analysis of a flue gas sample from coal firing should show 10.0 per cent CO_2, 5.0 per cent O_2 and no CO, there would be a strong possibility that the operator had lost some of the sample while conducting the oxygen absorption. If there had been merely incomplete absorption of the oxygen the remainder would have been absorbed in the CO pipette and then reported as CO. With 10 per cent CO_2, the oxygen should be about 9.0 per cent or slightly less. Discrepancies in reporting CO and possibility of hydroxylation will be discussed.

Modernizing a Small Factory Power System

Here is an article the small plant operator should find of interest. It deals with a plant that just grew like "Topsy." The boilers were old, the electrical system was a mess—there were two d-c voltages as well as an a-c system. Even after a new boiler was installed, costs were high, particularly compressed air costs. Mr. Gaylord shows how this plant was modernized, step by step; how a new a-c generator was installed, how further need for power was met by purchasing power from the power company, how the power factor was improved by the installation of capacitors. The problems involved here are exactly those existing in many small plants throughout the country and the procedure in this plant may serve as a guide in solving problems in others

By WILLIAM W. GAYLORD
Consulting Engineer Hamden, Connecticut

In the late fall of 1935 two of the three boilers in an Industrial Plant were condemned by the insurance company but with the provision that they might be used through the winter, for heating only, at an operating pressure of 15 lb gage. The plant heating system required the use of a direct acting steam driven vacuum pump which could not be made to run with 15 lb steam pressure.

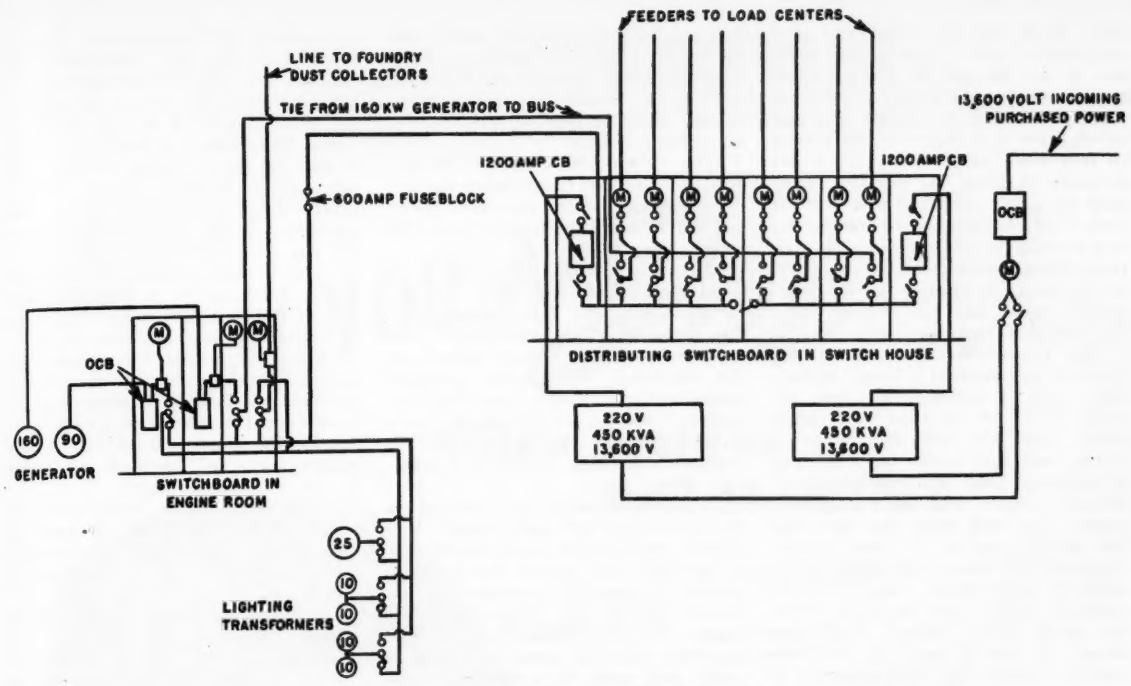
Thus if it should become necessary to shut the remaining boiler down for cleaning or repairs there would be no way of keeping the plant from freezing. The writer was called in and requested to go over the plant and determine the lowest boiler pressure at which reliable operation of the vacuum pump could be expected and find if permission could be secured from the insurance company to operate at this pressure through the winter.

The power plant consisted of the following equipment:

2—B&W boilers of about 165 hp (installed 1899)
1—Bigelow 260 hp hrt boiler (installed 1933)
2—6 by 4 by 6-in. direct acting duplex feed pumps
1—300 hp closed feedwater heater
1—6⅛ by 8 by 10-in. simplex vacuum pump
1—18 by 36-in. A.P. Allis Corliss engine running at 92 rpm belted to jack shaft and some line shafting
1—110 kw, 575 v, d-c generator belted to jack shaft
1—90 kw, 220 v, 3 phase, a-c generator belted to jack shaft
1—35 kw. 125 v d-c generator belted to jack shaft
1—30 kw 125 v d-c generator belted to jack shaft
1—14 by 9 by 14 in. air compressor driven by a 12 by 14 in. steam cylinder
1—16 by 11 by 18 in. air compressor driven by a 16 by 18 in. steam cylinder
1—13½ by 8 by 10 in. air compressor driven by a belt from jack shaft
1—9 by 9 in. air compressor driven by a motor

In addition to this equipment in the power house there was a connection to the utility power supply at the opposite end of plant through three 75 kva transformers for 220 v, 3 phase service.

The single boiler did not have sufficient capacity to run both steam driven air compressors and the engine at the same time, and the operating schedule had been changed so that the Foundry Cleaning Room was run only at night as this required the operation of both air compressors. Under this schedule only the small steam driven air compressor was run during the day and the engine was run to generate about half the



One-line diagram of the power distribution system

electric power required, while at night all electric power was purchased and both steam driven air compressors were operated.

Plant Operated on 60 lb Pressure

An investigation of the heating system, vacuum pump, boiler feed pumps and feedwater piping indicated that the lowest steam pressure at which the heating system, with no other steam driven equipment running, could be kept in operation was about 60 psi gage. Permission was therefore requested from the insurance company to have the safety valves on the old B&W boilers set at 70 psi gage with the understanding that they would be operated only when it was necessary to shut the other boiler down for repairs. This was granted with the provision that the old boilers would be replaced during the next summer.

It was then recommended that a second hrt boiler of the same size as the existing hrt boiler be installed to replace the old B&W boilers, that the steam header and steam mains be redesigned to eliminate the trouble from slugs of water reaching the engine and compressor cylinders that had been experienced with the old piping and that a new 7½ by 5 by 6 in. duplex feed pump be installed to replace one of the old ones which was worn out.

It was further recommended that a thorough study of steam, power and compressed air requirements and costs be made to determine what further changes in equipment and operation should be made.

The second boiler and new feed pump were installed and steam header and mains replaced in the summer of 1936 and a report on power requirements and costs submitted in the winter of 1937.

This showed compressed air costs to be high due to high steam consumption of old air compressors but that it would be more economical to replace them with modern steam driven compressors than motor driven compressors using purchased power because of the demand for exhaust steam for building heating for seven months of the year.

It also showed that it would be economical to continue to generate power by using the engine during the day shift as in this way the demand for purchased power could be held down to a point that made the cost per kwhr lower than if all power were purchased.

Two D-C Systems and One A-C System

It further showed that the power distribution wiring was very complicated due to the use of two d-c voltages and that the a-c generator could not be run in parallel with the purchased power. Many departments had three wiring systems while at other departments both a-c and d-c motors had been installed so that either could be used to drive line shafting for group drives. In spite of these multiple connections it was not possible to use either purchased or generated power to full advantage or secure the most desirable combinations of the two. Records showed that the maintenance costs on both the d-c generators and motors were increasing rapidly and were much higher than on similar a-c equipment.

The analysis of power and compressed air costs showed that the installation of modern steam-driven air compressors would give the best return on the investment with the then existing ratio between power and compressed air loads, but extensive changes in the equipment and methods of operation in the Foundry Department were under consideration which would materially increase the power demand and decrease the use of compressed air. The increase in the power load by these proposed changes could be accurately estimated but the decrease in the compressed air requirements could not be definitely determined until the new equipment and operating methods were in use.

It was then decided that the first step in modernizing the power supply would be to replace the three d-c generators by an a-c generator belted to the jack shaft. This would allow a material simplification of the power wiring and by the installation of a few interconnections with double throw switches make it so that any department could be operated by generated or purchased power and thus the most economical balance secured.

New A-C Generator Installed

A 200 kva, 220 v, 3-phase belted generator complete with panel, instruments and oil circuit breaker was found which could be purchased in good second hand condition at about one-fourth the cost of a new unit. This unit was purchased and installed in the summer of 1937 and has proved economical and satisfactory.

The installation of the new equipment in the Foundry in the summer of 1938 made an additional power supply necessary and it was decided to purchase this. As the power company's transformers supplying this plant were fully loaded this would require additional transformer capacity. The power company was just installing a 13,600 v line along the side of the plant nearest to the power house and desired to discontinue the use of the old transformers and furnish the whole plant supply from this line through new transformers. The fact that the secondary voltage had to be maintained at 220 v made it desirable to locate the transformers as near the

center of the load as possible and after considerable study of the spaces available it was decided to use a 3-phase pyranol filled transformer of 450 kva capacity located just outside of a new switch house to be built onto the present air compressor room. To do this it was necessary to bring the primary supply from the power company's pole over the roofs of two buildings to the transformer in a 3-conductor lead covered cable with fused primary cutouts at the connection to the power company's line and permission to do this was secured from the insurance company.

The transformer was ordered, but before it was received a slump in business made it necessary to omit the switch house for the time, so a simple service panel with 1200 amp air circuit breaker and fuse blocks for connecting to secondary mains was installed at wall between engine and air compressor rooms. One new main was run from this service panel to the new foundry equipment and connections from service panel to double throw switches at the generator panels were installed. With the double throw switches that were already in use at most of the load centers to shift load from generated to purchased power or vice versa a fairly satisfactory adjustment of loads between the two could be obtained.

In the summer of 1940 the power factor on the purchased power had fallen to a point where the power company was making small penalty charges. A check showed that this was due to the installation of many individual motor drives and that the only practicable way to correct the power factor was the installation of capacitors. Estimates showed that as long as the mains and transformer were not overloaded the savings by correcting the power factor to eliminate the penalty charges would not pay the fixed charges on the cost of installing capacitors.

Capacitors Installed

By the summer of 1941 the load had increased to such an extent that one of the mains was overloaded and the transformer was nearing its current capacity so a bank of capacitors was installed which raised the power factor on this main to about 90 per cent, and on the transformer to a little over 80 per cent. In the fall of 1941 it became necessary to run the engine all night to carry the night load.

Early in 1942 the load had increased to a point where all mains were overloaded and it was necessary to install two more banks of capacitors, one in the main from the transformer to the largest load group and one in the main from the 200 kva generator to its load group. These raised the power factor in both the purchased power and generated power systems to over 90 per cent and made it possible to carry the load until a second transformer for purchased power could be installed.

A second 450 kva, 3-phase transformer was immediately ordered. A check showed that the primary main from the power company's lines to the transformer would carry both transformers, but that a primary switch cubical with a primary oil switch of 150,000 kva interrupting capacity and disconnect switches for primary line to each transformer would be required and this was immediately ordered.

This cubical also contained the current and potential transformers for primary metering of the purchased power, but the meters were located inside the switch house.

A switch house was built and a six panel switchboard consisting of two service panels and four feeder panels was ordered. This switchboard was made up with two 3-phase busses, one for purchased and one for generated power and each feeder panel had two feeders connected through double throw switches so that any feeder could be supplied with either purchased or generated power.

A watthour meter was installed on the switchboard for each feeder. New feeders of ample size were run to each of the eight load centers and the three banks of capacitors connected to the feeders having the highest inductive loads. This distribution system provided an ample supply of power to all departments and made it possible to secure the most economical balance between purchased and generated power.

The one line wiring diagram shows arrangement of transformers, switchboard and generator connections and indicates the double throw switches for throwing the whole load of each generator from purchased to the generated power. Thus when it is found economical to run the engine during the day shift only, if a suitable balance between generated and purchased power has been established at the main switchboard for the day load, when the engine is shut down it is only necessary to throw the double throw switch at generator panel and to throw it back when the engine is started the next morning.

After the second transformer was installed so that sufficient capacity was available an analysis of electric power costs showed it to be more economical to operate the engine during the heating season only, and purchase all power in the non-heating season.

Under the rate at which power is purchased this condition will apply as long as the engine capacity represents less than 40 per cent of the total demand.

War conditions have so reduced the foundry output that the compressed air requirements have been materially reduced, but it is expected that with the return of normal business a modern steam driven compressor will be installed to supply all air required.

LETTERS AND COMMENTS

What Price Experience?

I HAVE BEEN working around power plants in this country for about twelve years. I have assimilated a little "Book-larnin'" from one or two textbooks I keep around me, in order to better understand the principles of my chosen trade. Owing to the always present, immediate, need of feeding my family I lack advanced education. Yet, I was satisfied for the niche I found for myself. I was happy the day I was first allowed to open the throttle to a steam engine or turbine. Synchronizing a generator on a board made me conscious of the power under my control, by the manipulation of a few knobs.

I have done a fair share of cleaning, soaping and oiling boilers and engines. My experience was gained in a larger Eastern city messing around with underfeed and overfeed stokers, steam and mechanical oil burners, with some hand-firing experience in between. I have operated at different times Corliss and slide-valve type engines. As I say, I now am satisfied to have reached being a stationary engineer.

I left the city, recently, and moved to an outlying town. I applied for a job in a nearby, well-known research and experimental laboratory. I was hired as a watch engineer in their boiler room. This plant consisted of two water-tube boilers rated 250 hp, each fired by B & W chain grate, forced draft stokers. There were turbine and motor-driven boiler feed-pumps, one 50 kva emergency generator driven by a Terry turbine; Copes feedwater controls and Brooke Engineering combustion controls.

In this plant here were three Gold Seal, a few Red Seal, a number of Blue Seal engineers; two Black Seal firemen and one or two laborers. The "Chief" was a Red Seal who, admittedly, had bought his ticket for $300. By this I mean he took an "over-night" school course in steam engineering. I believe he was a good electrician in his own right.

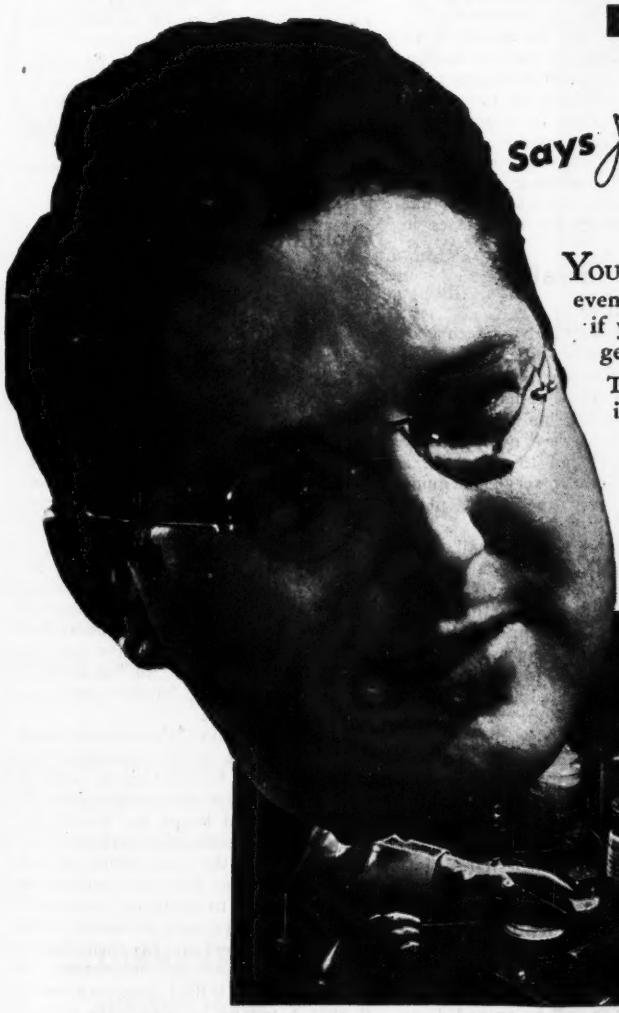
I was not there very long when I sensed an undercurrent of feeling between him and some of the other engineers. There were many stories told to me by the other engineers about the "Chief." I will not relate any as they were hearsay to me.

On my fourth week I was made relief engineer. I had to relieve three engineers on their day off and put in the other three days packing pumps, changing oil, etc. One day, the "Chief" pounced on me and ordered me to go into and clean the combustion passages of the boiler that was down. This, in the presence of the men whose job it was, fireman and laborers. I sensed that if he could get me to do it the other engineers would have had to follow suit or probably lose their jobs, seniority, etc. I refused, giving the reason that I have served my time cleaning boilers and that no place where I had worked had engineers been asked to do such work. I did not refuse to clean the inside of the drums or turbine the tubes, if necessary.

"RIGHT YOU ARE, Joe..."

Silica Scale is Bad Medicine"*

Says Jay T. Nicholson
Nalco Representative,
Tulsa, Oklahoma



YOU can expect boiler tubes to scale up pretty bad Joe, even in your closed system that returns 98% of the water, if you do not have proper water treatment... and, generally you are in for some burnt tubes too.

The logical way to keep boiler tubes slick as a whistle is through the use of Nalco water treatment. Nalco provides scientifically prepared chemicals, the benefits of advanced research and a competent service staff.

Bear in mind Joe, all water treatment is *not* alike ... remember, the Nalco system is *the complete system.* Ask for a survey today.

Photo in Nalco Laboratories

* Joe, a Chief Engineer at a Railroad Hospital has boiler trouble because of excessive amount of silica in the feedwater. He says — "a recommended compound helps a little but what we need is water treatment."

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nalco ... The Complete Water Treating Service

The argument was carried to the front office. Here I got a new angle on the "Professional versus Stationary Engineer" argument.

They explained to me that I was only to regard myself as an engineer when relieving other engineers. The other three days they could make me do any kind of work they wanted me to do. As a matter of fact they only gave me, they said, the three extra days to comply with the 48-hour week. The Personnel Manager agreed with me, but said that for me to gain my point would upset labor relations in other parts of the plant.

The upshot of the matter was they got an outside company to clean the boiler. I asked for and got my release. All this happened over two months ago. They still haven't got a man in my place. They never needed one in the first place. As I pointed out, they are just plain hoarding enough engineers to run a utility.

I have given up the game, temporarily, and have gone into production work. I will have to get a better perspective on power plant operation. I, too, must have been going around in circles to wind up where I started out—cleaning boilers.

Morristown, N. J. WILLIAM HARDING

High Voltage D-C Generators

FOR THE information of W. S. who proposes to build a high-voltage d-c generator the following patents dealing with non-commutated d-c generators may be of interest.

British Pat. to Lundell, 6069, May 12, 1900

U. S. Pat. to Engler, 1,492, 972, May 6, 1924

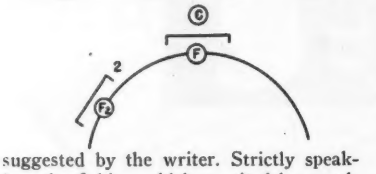
British Pat. to Vala et al, 269,859, Sept. 29, 1927

The inventors guilty of these patents propose to commutate the field circuits rather than the load circuits. It is generally held that such propositions are wacky and quite inoperative.

Richmond, Va. JOHN E. HENDRICKS

More on the H. V. D-C Generator

THANKS TO Mr. Gould for his letter in the August issue. The conditions outlined in Mr. Gould's last paragraph would not obtain in the d-c generator



suggested by the writer. Strictly speaking, the field would be excited by a pulsating, and not an alternating, current.

It is true that "When a magnetic field is forced across a conductor, a current is induced in that conductor". Consider Fig. 1, in which F is the field, and C is the conductor, and the rough rectangles their respective fluxes.

F is excited by a pulsating current coming from a bank of electron tubes, so designed as to give a wave of rectangular shape. (1). When this wave crosses C, a wave of somewhat similar shape (1b) would be induced into C. With the passing of F1, the induced current would fall sharply to Zero, or thereabouts. As F2 approaches, another wave 2b, would be induced into C.

The argument is raised, that a pulsating current would induce an alternating current. This is true for a coil which is wound around an iron core to furnish a magnetic circuit. When the field of this core reverses, a current in the opposite direction is induced in the coil. Thus, it is evident that the armature of this d-c generator would not have a magnetic circuit, as we know it.

We also know that electricity is not really generated in an armature. The electrons are there, and the impact of the field flux upon them sets them in motion. So it is evident that, with a d-c generator constructed as proposed by the writer, with the fields excited by a heavy pulsating current, and passing across an armature circuit composed only of a copper circuit, something would be bound to happen. And who would like a generator without the iron losses in the armature? W. S.

A Crack at Private Green's Neck

IN THE JULY ISSUE, Pvt. Green goes to some effort to have "his neck jumped on," even to the extent of daring anyone to refute his remarks. One hesitates to dampen his youthful enthusiasm as it is a rare quality these days but he does fail to recognize a few facts that might serve to guide his exuberance for the small plant operator.

Take his example of a small plant operator saving a ton of coal a day. There is not one chance in ten thousand that his means or methods are new. Practically every angle of power plant economy, particularly as it applies to the smaller plants with older equipment, has been described and discussed by textbook and magazine writers over and over again for years before Pvt. Green was born. Every plant operator has available or can obtain extensive treatises on plant efficiency and any operator who boosts his plant efficiency is intelligent enough to know that. So there is little wonder he hesitates or is reluctant to write about things that experts have covered so many times.

But suppose he does write up the idea or method and submits it to a trade journal. Unless it is unusually well written or has an unusual angle it's an even bet it will be turned down by the editor, in my own experience the odds have been worse than that.

Let us suppose, however, it is published, half of the 48,000 operators will never see the article, being either a non-subscriber, a non-reader or not interested. More than half of those reading it will find it does not apply to their plant or operating conditions. About three-quarters of the remainder will think the idea is worth investigating when the seven other matters on hand are cleared up and hence never get to it. Let us credit the remainder with doing something about it. So, Pvt. Green, if 15 per cent of the operators in the country really act on the suggestion it's a mighty good one, but you will have to revise those figures of yours a bit and discover the small plant operator who doesn't send in his idea is not losing the war.

And I might add that I think it is bad taste to be ramming it down our throats because we are not on the fighting line. Comparisons are always odious and attempting to highlight the shortcomings of civilians with the glory of our men at arms is not quite fair. For you see a man's "reluctance" is not necessarily a shirking of duty but simply reaction from his mature judgment and experience.

It is always well to abide by a little maxim I believe was handed down by a fighter of the old, old school, Davy Crockett, "Be sure you're right, then go ahead."

Philadelphia, Pa. THOS. W. BENSON

Perseverance and Proper Guidance

IN LOOKING over the July, 1944, issue of POWER PLANT ENGINEERING I noticed a letter from a Mr. Robert Baker.

Mr. Baker in this letter invited criticism and I think that he is entitled to criticism of the adverse variety.

One section of the subject letter contains the following, "He asked me to show him where certain pipe lines went. I did not." This quotation is very revealing and to my mind goes far toward counter-balancing whatever technical achievements the author of the quotation may have.

Mr. Baker seems to overlook the fact that he is also being paid to operate or assist in operating the plant in question. An engineer must never forget that he is working for the successful prosecution of the "job" as a whole and is not working "under" any particular personality.

To quote again, "Perseverance and proper guidance is it?" I answer that it is. If a man knows how to perform a certain operation, no matter how well, performs it and keeps the knowledge to himself the deed dies with its completion. If, on the other hand, he will take the time and have the patience to educate others to perform this operation, he will have been of lasting value to those he helped and his own character will have increased in stature. It may be well to reflect that very rarely if ever a person is born with a complete engineering education and if our forebears had not exhibited a certain amount of "Perseverance and proper guidance" we might still be trying to fit the first wheel to the first axle.

Any person in a supervisory capacity may "eliminate" a subordinate that is unsatisfactory. This "elimination" usually represents a loss for all parties concerned.

Only experience and "know-how" can make a casting like this; and only such a casting can make a Lunkenheimer Valve.

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A person that is able to do his own job and also to transform unsatisfactory co-workers from the "unsatisfactory level" to a "satisfactory, or better level" has aided his fellow man, his employer and his country.

His work will eventually result in better operation of his plant, in better living conditions of the families of the men he helped and in increase of his own stature.

My advice to Mr. Baker is that he examine himself to discover if, "Even he does funny things."

EMERY B. WOODWARD

North Charleston, S. C.

Correction Note

We wish to direct attention to an error which occurred in the article, entitled, "Adapting Oil Burner to Both Summer and Winter Use" by N. W. Duell, on page 96 of the August issue. In the last paragraph it was stated that an efficiency of .86 to 89 per cent was obtained. This was an error. In Mr. Duell's original manuscript, he stated that the efficiency obtained was 76 to 79 per cent, and these figures should have appeared in the printed article.

Questions And Answers

Question No. 272

How Much M-H Alkalinity Should This Boiler Water Show?

USING RAW feedwater of 7 gr per gal hardness, treated by a cold-process lime and soda softener, what M-H alkalinity (methyl-orange alkalinity) less soap hardness, should be maintained in the boiler water in a 500-hp, 4-drum, bent-tube boiler installed in a brewery?

We are getting some carry-over from this boiler but I suspect that this is because of poor manual regulation of water level at present. We have ordered a feedwater level regulator but it has not yet been delivered. The boiler load, a typical brewery load, varies between 1000 lb per hr and 29,000 lb per hr in 15 min. The boiler is equipped with a continuous blowdown system. It is fired by a dumping grate type spreader stoker.

In the cold-process softener, in addition to the soda and lime, we use another chemical, supplied by the softener manufacturer, which I assume is sodium aluminate and tannin. I suspect that we are using too much soda, also that we may not be regulating the continuous blowdown correctly That is why I want to know what conditions ought to be maintained in the boiler water itself.

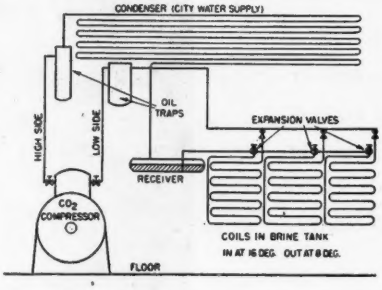
Chicago, Ill. E. O. D.

Question No. 273

How Clean CO_2 Evaporator Coils in Brine Tank?

WHAT is the best way to get oil out of the evaporator coils in the brine tank, in the CO_2 system shown in the accompanying diagram?

The CO_2 compressor is connected as shown. The returning gas line to the machine runs up as high as the bottom of the condenser, which is 7 ft above the brine tank.



There are three expansion valves, one for each coil, as shown. If you open these valves wide, you get slugs of liquid back to the machine.

Can the oil in these evaporator coils be floated out by filling one of the coils with liquid and using the other valve as an expansion valve?

Should we shut off the condenser water so the gas won't liquefy?

We carry 19 to 21 atmospheres back pressure.

Chicago, Ill. G. B.

Editor's Note—See answers to Question No. 208, March, May, June 1943.

Question No. 274

How About Aluminum Alloy and Steam?

HAVE ALUMINUM alloy die castings been satisfactorily used in contact with steam at 100 lb pressure?

Chicago, Ill. J. L. W.

Answer No. 257

What Causes Locking of Wound-rotor Motor?

IN THE APRIL ISSUE, C. W. S. said he had trouble in starting a wound-rotor motor in which the internal resistance had been removed and copper rings installed for compensator starting. He said it had to be rotated by hand a few degrees before it would start.

Start Under Reduced Load

THE MANNER of starting the motor has no bearing on its performance. Consequently, the current which flows to the external resistance, the slip rings, induces a voltage in the windings. The resulting flux reacts with the rotating field of stator and causes the rotor to turn.

If the frequency of supply line for the compensator is the same as the motor is designed for, I cannot quite comprehend why the compensator starting manner should have any significance.

However, short circuiting of slip rings is not feasible, because the operation of wound-rotor motors depends upon their resistance. But if I am not misinformed, the motor in question is lap wound, so the leads or pole phase groups can be connected incorrectly after the internal resistance was removed.

To sum up, my advice is to remove the short circuiter and start the motor under reduced load.

New York City CORP. CARL EGERTER

Answer No. 258

Why Install a By-Pass Around a Pump Governor?

WHAT ARE all the reasons, asked J.R.H. in the April issue, why a by-pass should be installed around the pump governor on each of his two new 8 by 5 by 10-in. duplex boiler feed pumps and is there any reason why a by-pass should *not* be installed? Steam supply lines are 1½-in., the pump governors are 1-in. and there are relief valves on the pump discharge lines.

Five Reasons from Gray

INSTALLATION of hand control on by-pass is for the following reasons: 1. To operate more than one pump if boiler evaporation is unusually high; 2. To try pump after repairs are made, i.e., repacking, valve setting, plunger packing, etc.; 3. In the event that there is any trouble on the governors, one may be out of service for repairs and the other could give out; 4. In the event that a hydrostatic test of boiler off the line is to be conducted; this, of course, would require piping and valving of the discharge side with an additional relief valve set for test pressure; 5. On ships, pumps are designed and piped for general service. Could not these pumps also be used for tank pump standby, fire pump standby, other services?

New York, N. Y. EDWARD W. GRAY

Reasons from Parks

THE PRIMARY REASON for installing a by-pass around a pump governor is so that the pump can be operated in case of failure of the governor. The governor can and does fail just when no other pump is available and if it were not for the by-pass, the pump may have to be shut down. When a by-pass is installed, the governor can be repaired or adjusted while the pump runs on throttle. The use of a by-pass sometimes makes starting up easier and safer because sometimes, a governor will stick and operate sluggishly until it gets hot. The by-pass also allows the pump to be speeded up quickly when more water

PLAN YOUR PLANT DRIVE NOW!

Good organization will be needed to sell the 6th. The task of raising the huge sum required will be the most difficult ever asked of Industry. As each new military success brings us closer to Victory, the public naturally will feel that the urgency of war financing is lessened—whereas it isn't. So organize now to prevent a letdown on the home-front from causing a letdown on the fighting front. Build your plant's payroll campaign around this fighting 8-Point Plan. You don't have to wait for the official Drive to start—swing into action NOW!

1 **BOND COMMITTEE**—Appoint a 6th War Loan Bond Committee from labor, management and each representative group of the firm.

2 **TEAM CAPTAINS**—Select a team captain, for each 10 workers, from men and women on the payroll—but not in a supervisory capacity. Returned veterans make most effective captains.

3 **QUOTA**—Set a quota for each department and each employee.

4 **MEETING OF CAPTAINS**—Give a powerful presentation of the importance of the work assigned to them. Instruct them in sales procedure. Have them carefully study the Treasury Booklet, *Getting the Order.*

5 **ASSIGNMENTS**—Assign responsibilities for:
(a) *Music, speeches and announcements of the opening rally.*
(b) *Pre-drive letter to employees from management and labor.*
(c) *Competitive progress boards.*
(d) *Meeting schedules, etc.*

6 **CARD FOR EACH WORKER**—Dignify each personal approach with a pledge, order, or authorization card made out in the name of each worker. Provide for a cash purchase or installment pledge. Instruct each captain to put a pencil notation on the card to indicate the subscription he expects to solicit from each worker.

7 **RESOLICITATION**—People don't mind being asked to buy more than once. Resolicit each employee toward the end of the drive in a fast mop-up campaign. Call upon your State Payroll Chairman; he's ready with a fully detailed plan—NOW!

8 **ADVERTISE THE DRIVE**—Use all possible space in the regular media you employ to tell the War Bond story.

The Treasury Department acknowledges with appreciation the publication of this message by

POWER PLANT ENGINEERING

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council

is needed than the governor will produce as in case of an emergency.

Baltimore, Md. CHAS. W. PARKS

Reasons from Brown

J.R.H. SAYS that his duplex pumps are 8 by 5 by 10 in. and that his governors are 1 in. I expect that his header pressure is 150 psi or he may be troubled with his pumps running slow. That would be one reason for by-passing the steam, as it seems to me that a 1-in. steam line may not allow enough pressure through at all times, so he may have to open the 1½-in. by-pass.

If these governors are of the type with water pressure cylinders to operate the steam valve, the leathers leak sometimes and the governor then has to be repaired with a new leather washer. If at that particular time J.R.H. didn't have a by-pass around his governor, that pump would have to be shut down until the governor was repaired. Sometimes that can be done in a short time, then again trouble develops, nuts strip, etc., especially if the operator in charge should get a little excited as would be the case.

Sloat, Calif. R. L. BROWN

Reasons from McNally

THE BY-PASS around this pump control valve is obviously designed to give a direct steam supply to the pump in case of failure of the automatic valve. If properly designed, this arrangement should have a shut-off valve on each side of the control valve so that, in case of failure, the defective valve can be dismantled and repaired while the pump is operating by steam through the by-pass. During this time, of course, the pump must be under manual control. It is also convenient in emergencies sometimes to operate with the by-pass slightly open if the control should suddenly get out of order but this is only temporary.

Kearney, N. J. GEO. MCNALLY

Answer No. 260

How Prevent Spontaneous Combustion of Coal in Silos and Bins?

Store Only Dry Coal, Watch the Height

MUCH HAS BEEN SAID and written on E. H. R.'s question but, after 12 years of handling slack coal in bunkers and stock piles out of doors, I have come to the conclusion that the best way to put out a fire in silos or bunkers is not to let them get started.

I am satisfied that if only *dry coal* is stored it is a safe bet that no fire will develop for two or three months. On the other hand, if wet coal is put in silos or bunkers a fire will develop in three weeks. This applies to coal in stock piles out of doors. However, if a fire does get started, about the only way to put it out is to remove the coal as quickly as possible and keep the top sprinkled lightly with water from a small hose to keep the fire from breaking out.

Care should be taken when constructing silos or bins, that there is not any space for gas to collect in. This is one of the big dangers. As coal begins to heat, gas is driven off and collects in these pockets, and will ignite under pressure.

As to the question of W. N. S., he wouldn't be in any more danger with his bin 100 ft long than he would with it 50 ft. It's the height he wants to watch out for; 16 ft is too high for slack coal to be piled for any length of time. Would suggest, however, that fire walls be constructed across the bin, so as to make several small bins. Then if a fire did get started in one, it could be quickly cleaned out and keep it from spreading to the rest of the bin.

Vergennes, Vt. R. E. WHITTY

Answer No. 266

How Calculate Efficiency of This 2500-kw Turbine?

IN THE JULY issue, R. B. M. asked for the correct method of calculating the thermal efficiency of a multi-stage condensing extraction turbine driving a 3125-kva generator. On page 106, July issue, he gave a tabulation of steam flow, pressure and temperature data from this machine, together with the manufacturer's guaranteed water rate and extraction curves. He asked for a computation of the actual efficiency of the turbine and the overall engine efficiency, with definitions of their meaning in this case, stating that a temperature-entropy or total heat-entropy diagram would help him understand the situation.

W. Heidecker has kindly obliged with an H-S diagram, while both he and Alfred W. Fox have discussed the calculations in detail as given below.

Solution by Heidecker

IN ANSWERING Question No. 266, let us arrange the information given in the form of a streamlined heat balance, reducing all units of energy to a common unit of 1,000,000 Btu and write it "$\times 10^6$ Btu," also using Btu per month instead of the conventional pounds per hour.

The shaded part of the stream in Fig. 1 represents the Btu that remain in the system and recirculate.

To illustrate the distribution of heat energy in another manner; let the total heat energy be represented by the coal pile, as shown in Fig. 2.

Distribution of the heat energy in the water cycle is illustrated in Fig. 3. Let a pie represent the heat energy added to the water cycle. The heat charged against the cycle for electricity would be the heat losses involved in the generation of the electricity, or 7.6% + 0.05% + 22.15% = 29.8%.

To explain engine efficiency, let us construct a chart, similar to the Mollier Diagram, showing entropy, enthalpy (total heat), and gage pressure as in Fig. 4. The horizontal lines on our chart represent enthalpy. The way to get the total heat of a pound of steam is to submerge it in a quantity of water and calculate the Btu from the rise in the temperature of the water. The slanting lines are gage pressure. The vertical lines are entropy.

Entropy (change of entropy) is roughly the ratio of the Btu added to or subtracted from a pound of steam, to the average temperature absolute at which the addition or subtraction was made. The purpose of using entropy on the chart? When a part of the heat energy of a pound of steam is converted into kinetic energy, the entropy of the heat energy remaining in the steam does not change.

We can roughly calculate the entropy of R. B. M.'s throttle steam. The heat required to evaporate one pound of water at 394 F is 832 Btu and the absolute temperature (394 + 460) is 854 F. 832 ÷ 854 = 0.975 and is called the entropy of the heat of evaporation. The heat required to raise the temperature from 32 F to 394 F is about 368 Btu and absolute temperature about 660 F. 368 ÷ 660 = 0.558 and is called entropy of the heat of the liquid. The heat added as superheat is 36.2 Btu at the absolute temperature of 882 F. 36.2 ÷ 882 = 0.041. The entropy would be 0.041 + 0.558 + 0.975 = 1.574.

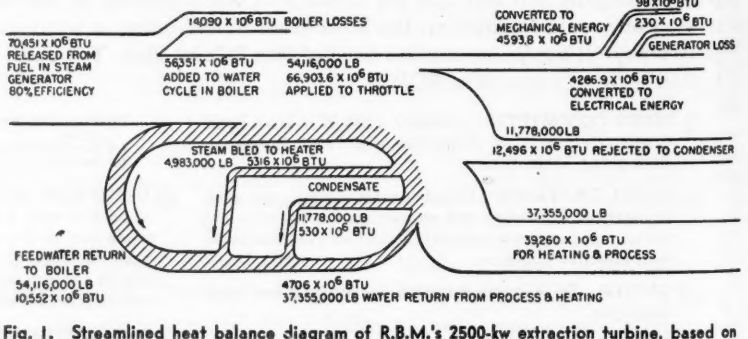

14090 X 10⁶ BTU BOILER LOSSES
70,451 X 10⁶ BTU RELEASED FROM FUEL IN STEAM GENERATOR 80% EFFICIENCY
56351 X 10⁶ BTU ADDED TO WATER CYCLE IN BOILER
54,116,000 LB 66,903.6 X 10⁶ BTU APPLIED TO THROTTLE
CONVERTED TO MECHANICAL ENERGY 4593.8 X 10⁶ BTU
TURBINE LOSS 98 X 10⁶ BTU
230 X 10⁶ BTU
GENERATOR LOSS
4286.9 X 10⁶ BTU CONVERTED TO ELECTRICAL ENERGY
11,778,000 LB
12,496 X 10⁶ BTU REJECTED TO CONDENSER
STEAM BLED TO HEATER 4,983,000 LB 531.6 X 10⁶ BTU
CONDENSATE
11,778,000 LB 530 X 10⁶ BTU
37,355,000 LB
39,260 X 10⁶ BTU FOR HEATING & PROCESS
FEEDWATER RETURN TO BOILER 54,116,000 LB 10,552 X 10⁶ BTU
4706 X 10⁶ BTU 37,355,000 LB WATER RETURN FROM PROCESS & HEATING

Fig. 1. Streamlined heat balance diagram of R.B.M.'s 2500-kw extraction turbine, based on data given in tabulation, page 106, July 1944 issue. Btu recirculating in system represented by shading

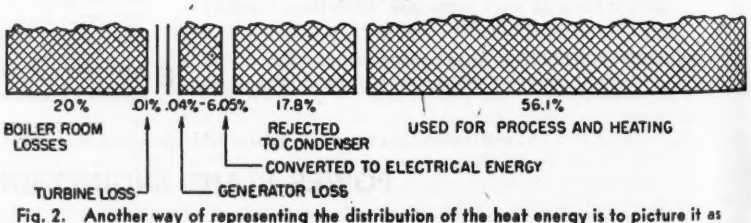


Fig. 2. Another way of representing the distribution of the heat energy is to picture it as a coal pile, various sections of which go for different purposes

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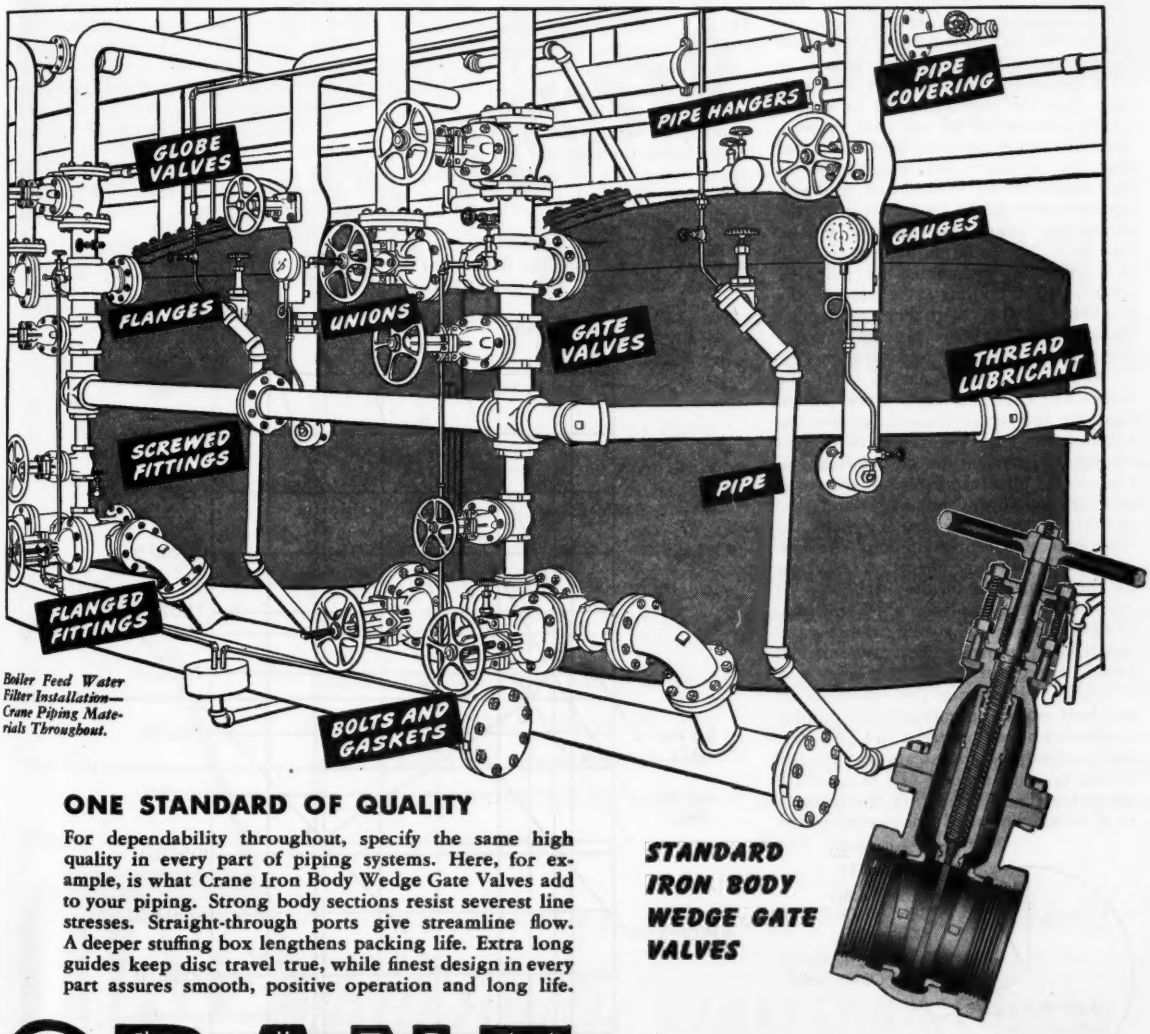

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STANDARD IRON BODY WEDGE GATE VALVES

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Tabulation of Steam Data—See Calculations top col. 1, page 116

	No. 1 Turbine		No. 2 Turbine	
	Throttle	Exhaust	Throttle	Exhaust
Pressure	216 psi	43 psi	43 psi	¾ in. Mercury
Entropy	1.574	1.65	1.65	2.04
Enthalpy	1236.3	1176.9	1176.9	1060
Btu Available		114.3		306
Btu Converted		59.4		117
Engine Eff.		52%		38.3%
Lb Water Used		54,116,000		11,778,000
Kwhr Generated		874,810		375,390
Water Rate		62		31
Thermal Eff.	3214.5 ÷ 66903.6 = 4.8%		1379.2 ÷ 13780 = 10%	
Overall Thermal Eff. of Turbine	4593.8 ÷ 56,351 = 8.15%			
Overall Engine Eff. of Turbine	54,116,000 × 114.3 = 6185.4 × 10^6 Btu		11,778,000 × 306 = 3604 × 10^6 Btu	
Total Kinetic Energy 9789.4 × 10^6 Btu				
4593.8 ÷ 9789.4 = 46%				

For an example, let us say we have a divided box, insulated, with a small opening in the central partition. Let there be a constant pressure supply of steam (100 psi) in the first box. Place temperature and pressure gages in each box and in the orifice in the partition. Let the steam expand to atmospheric pressure (14.7 psi abs) through the orifice to the second box. We find that the pressure and temperature of the steam in the orifice has dropped, because part of the heat energy of the steam has been converted to kinetic energy. The condition of the steam in the orifice is represented by point M on the chart. Point O represents the condition of the steam before entering the orifice. O to M represents the conversion of heat energy to kinetic energy.

When the steam passes from the orifice and comes to rest in the second box, the temperature rises because the kinetic energy has reverted back to heat energy. The condition of the steam in the second box (atmospheric pressure) is represented by point N and the changing of kinetic energy back to heat energy is represented by the line M to N. This entire operation is known as throttling and occurs in nearly all turbines. The condition line of throttling is O to N. Throttling reduces the available heat energy for conversion to kinetic energy in the heat engine.

When calculating the efficiency of any heat engine operating under similar conditions of temperature and pressure, the condition of the steam leaving the engine must be a point (P) somewhere along the line M to N. A line from O to P would be called the condition line of an engine operating at 50 per cent efficiency.

To locate the condition line of R. B. M.'s turbine, the amount of steam passing through the blades of each section must be considered. We really have two turbines, a tandem compound job; a dry turbine (No. 1), and a wet condensing unit (No. 2), the bleeder point being the division line; the pressures being 216 psi and 43 psi respectively on the first row of nozzles of each turbine.

To locate the condition line on the chart, of No. 1 turbine, find point A, throttle condition 216 psi, 1.574 entropy, 1236 Btu. Next locate point B, entropy 1.574, 43 psi. Line A to B indicates the transformation of heat energy to kinetic energy in the turbine nozzles. Now locate the point of intersection of 43 psi line with 1177 enthalpy line. This is the end point D, the condition of the exhaust steam, and the line A to D is the condition line of No. 1 turbine.

To find the condition line of No. 2 turbine, point D is throttle condition. The heat energy available is again located by the intersection of the pressure line ¾ in. mercury with the entropy line 1.65, point E. D to E indicates the transformation of heat energy to kinetic energy. To locate the end point of No. 2 turbine, we must know how many Btu's were rejected to the condenser.

We know that the Btu converted to mechanical energy must be less than 306 per lb, and that 11,778,000 lb of steam pass through the turbine to the condenser, and that there are 3413 Btu in every kwhr we generate. We believe that R. B. M.'s generator is 95 per cent efficient, so that 3582.63 Btu must be delivered on the shaft of the generator to generate one kwhr.

It stands to reason there are some turbine losses of mechanical energy being converted back to heat in the bearings and gland seals. This can be calculated roughly as follows:

$$1.00 - \sqrt[4]{\frac{\text{Kilowatt rating}}{1000}} = 0.975$$

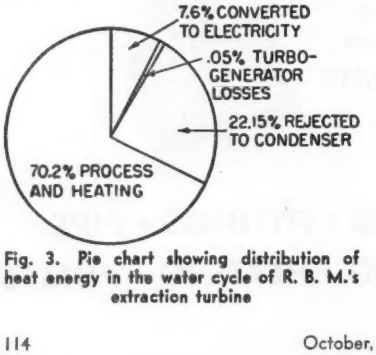


Fig. 3. Pie chart showing distribution of heat energy in the water cycle of R. B. M.'s extraction turbine

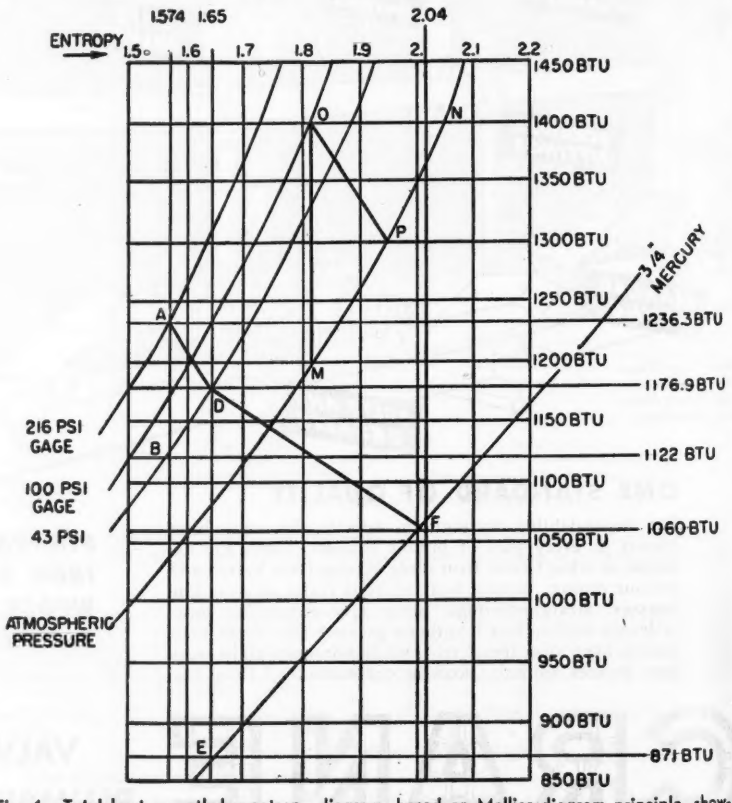
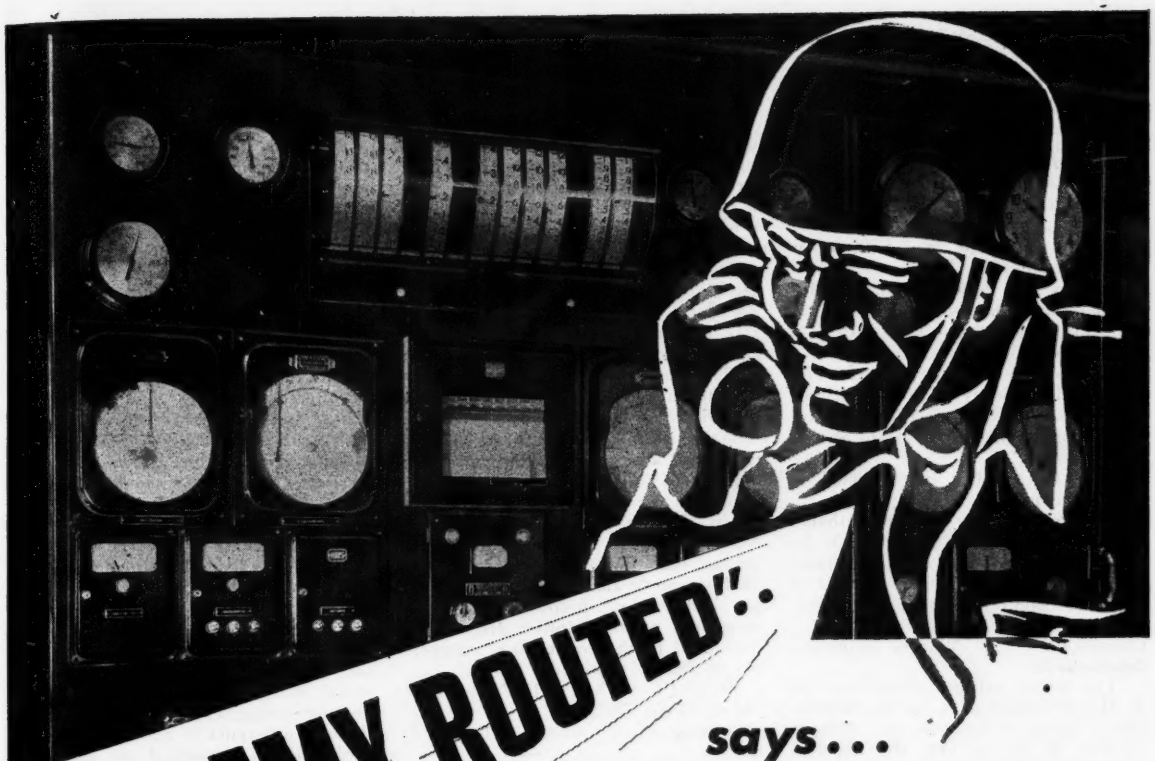


Fig. 4. Total heat or enthalpy-entropy diagram, based on Mollier diagram principle, showing relations between factors in R. B. M.'s turbine



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3582.63 ÷ 0.975 = 3674.5 Btu actually converted to produce one kwhr.

1,250,200 kwhr × 3674.5 = 4593.8 × 10^6 Btu converted to mechanical energy in both turbines.

54,116,000 lb pass through No. 1 turbine, so 54,116,000 × 59.4 Btu = 3214 × 10^6 Btu converted. 3214 × 10^6 ÷ 3674.5 = 874,810 kwhr No. 1 turbine generates.

1,250,200 — 874,810 = 375,390 kwhr generated by No. 2 turbine.

375,390 kwhr × 3674.5 = 1379.2 × 10^6 Btu available in No. 2 turbine.

306 × 11,776,000 lb = 3604 × 10^6 Btu available in No. 2 turbine.

1379.2 ÷ 3604 = 38.3 per cent mechanical efficiency of No. 2 turbine.

306 × 38.3 per cent = 117 Btu actually converted per lb steam No. 2 turbine.

1177 — 117 = 1060 Btu rejected to the condenser.

The intersection of the enthalpy line 1060 and the pressure line ¾ in. Hg is the end point or the exhaust condition of No. 2 turbine. Line D to F is the condition line of No. 2 turbine.

Chicago, Ill. WALTER HEIDECKER

Solution by Fox

THE RATED exhaust pressure of R. B. M.'s turbine is 27½ in. Hg vacuum. Since inches of vacuum are normally referred to 30 in. Hg, the absolute pressure would be 2½ in. and slightly less if referred to 32 F. This does not check with the 1½ in. stated in the text, which would be correct only for abnormal altitude. The text states that the back pressure averaged 1.35 in. and the tabular data shows 0.7 in. Since a difference of only 1 in. would make a great difference in water rate and efficiency, widely divergent answers may be obtained depending on the exhaust pressure used. The discrepancy may be due to confusion between inches and pounds Hg. The writer has chosen to use 2½ in. rated and 1.35 in. actual.

Turbines, like engines, are ordinarily referred to the Rankine cycle. The thermal efficiency and Rankine cycle ratio for rated or design conditions may be obtained as follows: Plot on a Mollier, or total heat entropy diagram, the point corresponding to 250 psi gage (265 psi abs) and 490 F TT. Call the total heat H_1. Project vertically downward, on constant entropy line, to 2½ in. abs and call this H_2. Then

H_1 = 1257 Btu/lb
H_2 = 894 Btu/lb

Heat Available = 363 Btu/lb

From steam tables, obtain the temperature of the liquid corresponding to 2½ in. and call this q_2. The thermal efficiency of a turbine developing the full power available on the Rankine cycle would be

$$\frac{H_1 - H_2}{H_1 - q_2} = \frac{363}{1257 - 77} = 30.75 \text{ per cent}$$

Since R. B. M.'s turbine, condensing, at 1880 kw, has a water rate from the curve of 14.33 lb per kwhr, its Rankine cycle ratio is 3415 ÷ (14.33 × 363) = 0.655, that is, it converts 65.5 per cent of the Btu available into power, and its thermal efficiency referred to the Rankine cycle is 30.75 × 0.655 = 20.15 per cent.

Similarly, the Rankine cycle ratio may be obtained for maximum bleeding and for any rate between this and zero bleed and a different answer will be obtained for each rate of extraction. While this will not help R. B. M., it does indicate that thermal efficiency, as such, is rather meaningless in connection with an extraction turbine. It would be much more helpful to compare the turbine with a compound engine with receiver bleed.

The problem is complicated slightly by the fact that at maximum bleed conditions for any load, some cooling steam is passing through the last stages to the condenser. From the curve this appears to be 3500 lb per hr. Now, also from the curve, bleeding 63,700 lb per hr, throttle flow = 73,000 lb per hr. 73,000 lb per hr maximum bleed develops 1623 kw. The water rate of bled steam = 73,000 ÷ 1623 = 45 lb per kwhr. Now, following the same procedure on the Mollier diagram as first used in the condensing example:

H_1 at 265 psi abs and 490 F TT = 1257 Btu per lb
H_2 at 65 psi abs same entropy = 1137 Btu per lb

Heat available, bled steam = 120 Btu per lb

3415 ÷ (45 × 120) = 0.631 Rankine cycle ratio.

Now, considering the low pressure stage, 73,000 — 63,700 = 9300 lb per hr total steam to condenser, and 9300 — 3500 lb per hr cooling steam, considered in with bled steam, = 5800 lb per hr.

1880 kw — 1623 = 257 kw on condensed steam, and

Water rate = 5800 ÷ 257 = 22.5 lb per kwhr, and

3415 ÷ [22.5 × (1137 — 894)] = 0.624 Rankine cycle ratio.

It is now possible to consider R. B. M.'s turbine at actual operating conditions.

H_1 at 231 psi abs and 450 F TT = 1236 Btu per lb
H_2 at 43 psi gage same entropy = 1123 Btu per lb

Heat available, bled steam = 113 Btu per lb

Assuming same Rankine cycle ratio,

Water rate = 3415 ÷ (113 × 0.631) = 47.9 lb per kwhr.

$$\text{Then, } \frac{63{,}700 + 3500 + X}{47.9} = Y \text{ kw} \quad (1)$$

and 1880 — Y = kw generated condensing

and X ÷ 20.7 = 1880 — Y kw (2)

Solving equations (1) and (2) simultaneously gives X = 6850 lb, and Throttle flow = 63,700 + 3500 + 6850 = 74,050 lb per hr.

The 20.7 water rate in equation (2) was obtained as follows:

H_1 at 43 psi abs = 1123 Btu per lb
H_2 at 1.35 in. Hg abs = 858 Btu per lb

Heat available = 265 Btu per lb

and, assuming same Rankine cycle ratio, 0.624,

Water rate = 3415 ÷ (265 × 0.624) = 20.7 lb per kwhr.

Since the turbine uses 81,300 lb per hr by meter, it is only 74,050 ÷ 81,300 = 91.1 per cent as efficient as it should be. It seems, to the writer, that this is actually the sort of efficiency R. B. M. is looking for, and, since the actual operating conditions affect the steam flow so slightly, it would be just as suitable for his purpose to compare the actual steam flow with that obtained from the curve furnished, which would greatly simplify his computations.

The foregoing method of correcting for altered operating conditions is, at best, only approximate, since Rankine cycle ratios will vary slightly with the changed initial, bleed and exhaust pressures, and also with the changed ratio of loads carried by bled and by condensed steam. Furthermore, the guaranteed curve is correct only for instantaneous load conditions and cannot be expected to check with monthly average conditions. A little study of average water rates for half time operation with maximum extraction and half time straight condensing, compared with full time operation with average extraction, at 1880 kw load, shows a difference of about 5 per cent.

It should be pointed out also that a series of analyses such as the foregoing may be used to calculate correction curves, or the manufacturer may be able to supply such curves, which could be used for approximating water rates with varied conditions.

R. B. M. asks the percentage of steam chargeable to electric generation. Obviously, if the throttle flow is 54,116,000 lb and the extraction flow 42,338,000 lb, the difference, or 11,778,000 lb, is directly chargeable. This amounts to 21.7 per cent. If this figure is used, as surmised, to charge a portion of the total fuel expense, a correction should be made for the difference in Btu content of the live and extracted steam, since, in the absence of electric generation, it would be necessary to generate steam at 43 psi gage, 290 F only. This ratio may be computed as follows, based on 227 F feedwater:

Electric generation, Btu per lb = 1236 — 195 = 1041 Btu per lb.

No electric generation, Btu per lb = 1177 — 195 = 982 Btu per lb.

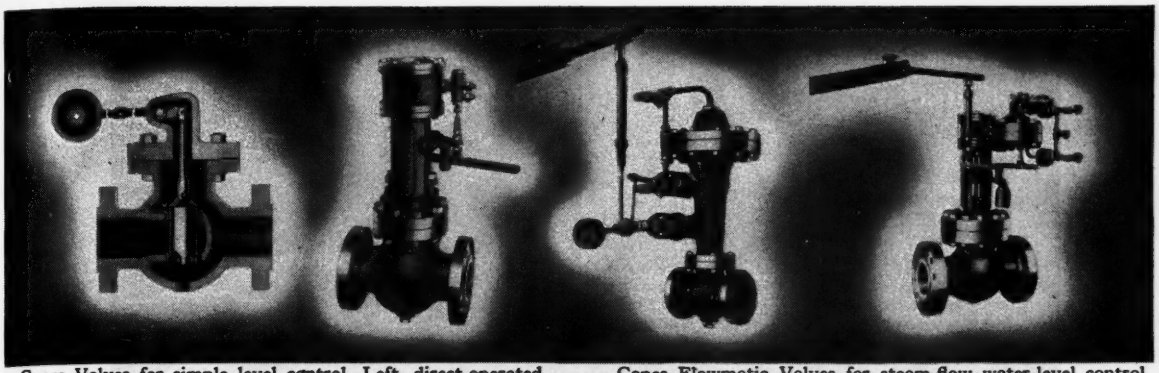
54,116,000 × 1041 = 56,500,000,000
42,338,000 × 982 = 41,600,000,000

Difference = 14,900,000,000

and the ratio is 14.9 ÷ 56.5 = 26.4 per cent. This is the figure the writer would use in prorating expenses.

R.B.M. also brings up generator efficiencies and separate turbine thermal efficiencies. If the thermal efficiencies and Rankine cycle efficiencies calculated above are divided by the generator efficiency corresponding to the load, the bare turbine figures will be obtained, on a "per brake kwhr" basis, which can be converted to hp. This is rarely done with turbines driving electric generators.

Westbury, L. I., N. Y. ALFRED W. FOX



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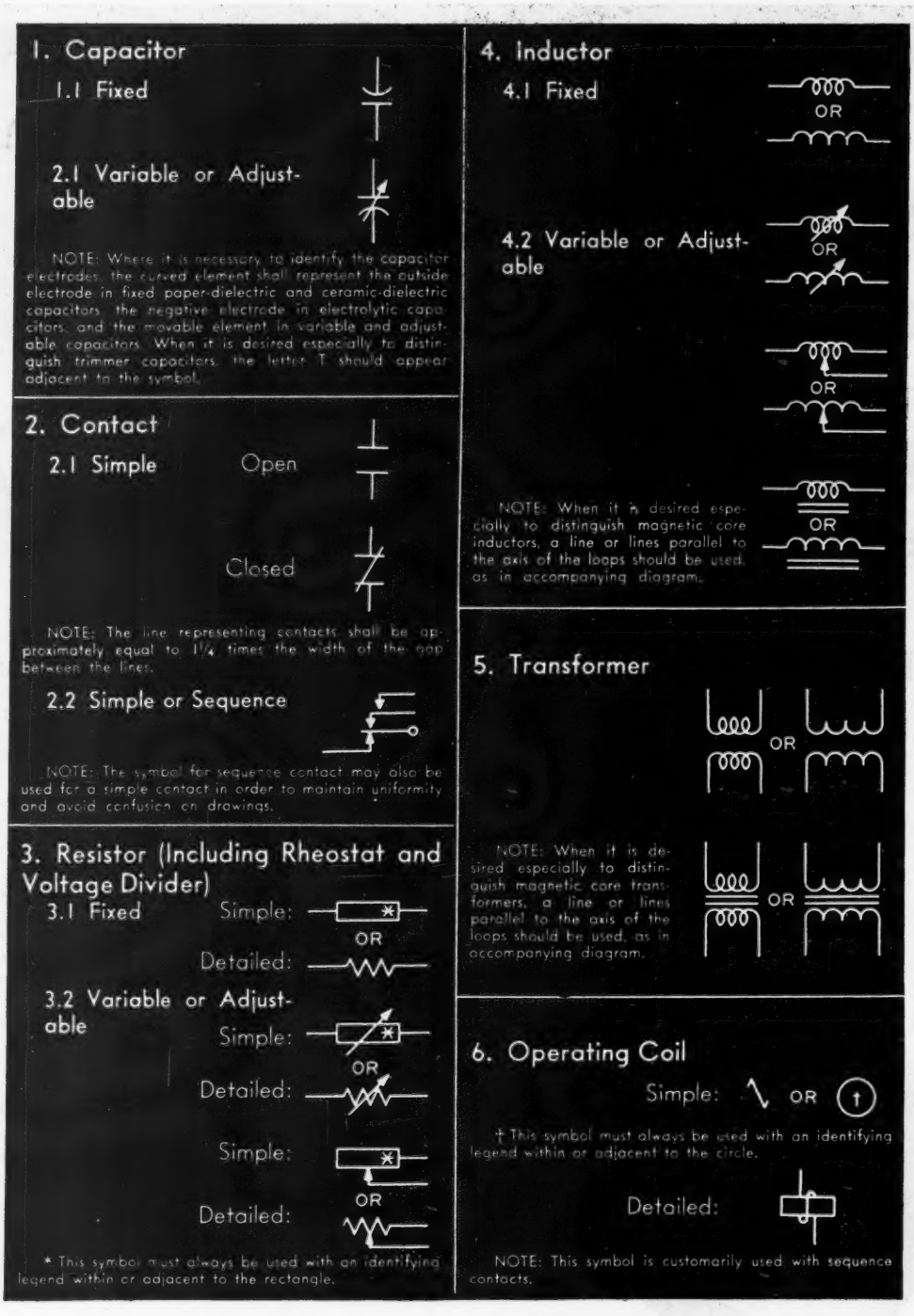
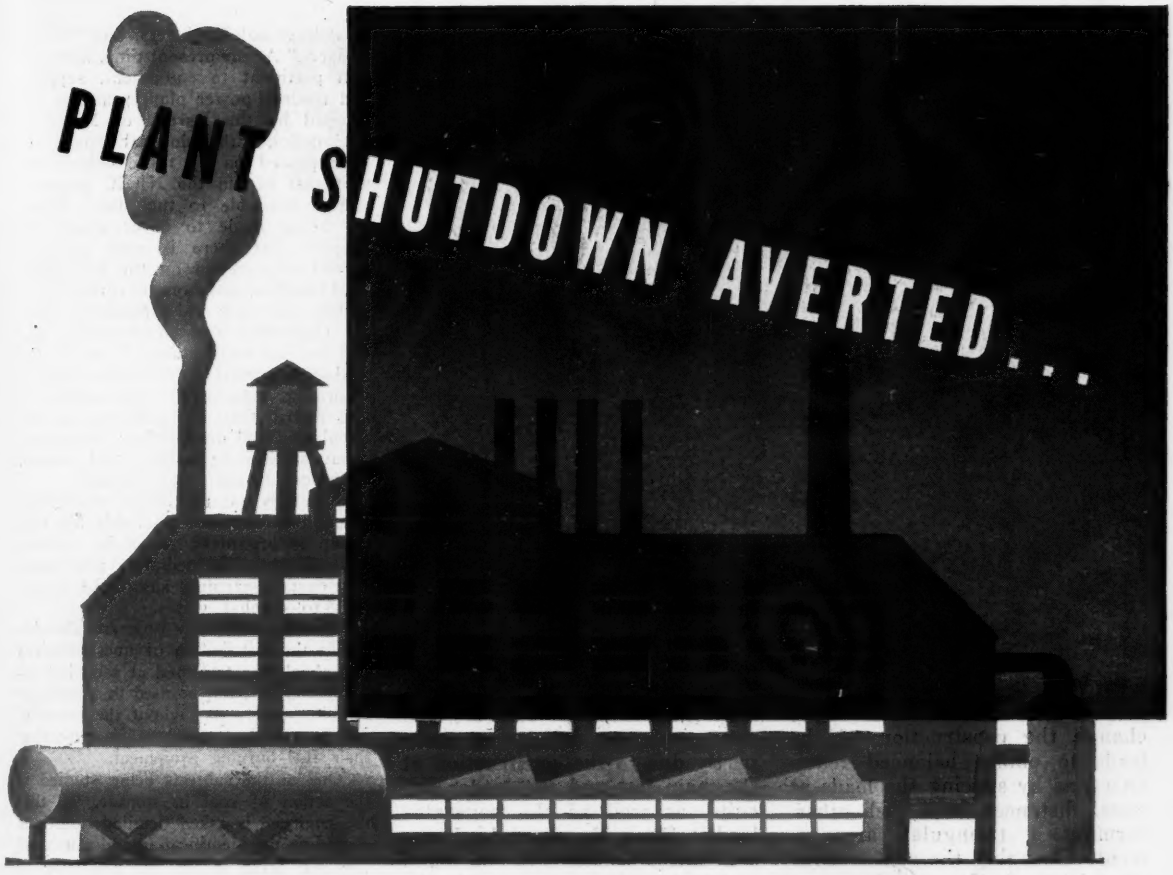

1. Capacitor
1.1 Fixed
2.1 Variable or Adjustable
NOTE: Where it is necessary to identify the capacitor electrodes, the curved element shall represent the outside electrode in fixed paper-dielectric and ceramic-dielectric capacitors, the negative electrode in electrolytic capacitors, and the movable element in variable and adjustable capacitors. When it is desired especially to distinguish trimmer capacitors, the letter T should appear adjacent to the symbol.
2. Contact
2.1 Simple
Open
Closed
NOTE: The line representing contacts shall be approximately equal to 1¼ times the width of the gap between the lines.
2.2 Simple or Sequence
NOTE: The symbol for sequence contact may also be used for a simple contact in order to maintain uniformity and avoid confusion on drawings.
3. Resistor (Including Rheostat and Voltage Divider)
3.1 Fixed
Simple:
OR
Detailed:
3.2 Variable or Adjustable
Simple:
OR
Detailed:
Simple:
OR
Detailed:
* This symbol must always be used with an identifying legend within or adjacent to the rectangle.
4. Inductor
4.1 Fixed
OR
4.2 Variable or Adjustable
OR
OR
OR
NOTE: When it is desired especially to distinguish magnetic core inductors, a line or lines parallel to the axis of the loops should be used, as in accompanying diagram.
5. Transformer
OR
NOTE: When it is desired especially to distinguish magnetic core transformers, a line or lines parallel to the axis of the loops should be used, as in accompanying diagram.
OR
6. Operating Coil
Simple:
OR
† This symbol must always be used with an identifying legend within or adjacent to the circle.
Detailed:
NOTE: This symbol is customarily used with sequence contacts.

Coordination of Electrical Graphical Symbols

The coordination of electrical graphical symbols shown on this chart was brought about by the work of a number of technical societies and trade associations under the general direction of the American Standards Association. There had been a long standing conflict in electrical symbols between the fields of electrical communication and power, control and measurement. The war accelerated the overlapping of these fields and the resulting confusion in the meaning of symbols became serious, especially in the industrial electronics field. As a result of meetings between interested groups, agreement was reached and a new American War Standard was issued by the American Standards Association incorporating the above symbols. Copies of the new standard, Z32.11—1944 can be obtained for 10 cents from the ASA, 29 W. 39th St., New York, N. Y.



. . . during CHANGEOVER

Recurrent tube failures in 4 twenty-year-old straight tube boilers were giving a large eastern chemical plant plenty of trouble. At least one boiler was always off the line for tube replacements, making it extremely difficult to carry the load with the remaining boilers. Plant management decided to replace the four old boilers with two modern units, but this decision introduced another problem; dismantling two boilers to install the first new unit would throw the entire load on the remaining two boilers, and the new boiler would have to carry the load during the final stages of installation. The operational hazards of making these changes were obvious. *How could plant shutdown be avoided during the changeover?*

W. H. & L. D. BETZ was consulted and a chemical engineer was dispatched to the plant where he "lived with the job" for two weeks. As a result of his studies and recommendations tube failures were stopped within ten days. Two old boilers carried the entire load without a single tube loss while the first new boiler was installed, and the new boiler carried the load during the installation of the second unit. *The plant has now operated continuously for several years without a single tube failure.*

The solution of these problems involved correct operation of the lime-soda softener, the application of proper internal treatment, and training of plant personnel in the efficient control of boiler feed water conditioning. It illustrates how the facilities of this nationwide organization of chemical engineers are employed to quickly and effectively solve problems relating to industrial water conditioning.

CHEMICAL ENGINEERS AND CONSULTANTS ON
ALL WATER PROBLEMS

W. H. & L. D. BETZ
FRANKFORD • PHILADELPHIA • PENNA.

Current Balancing Reactors for Turbine Generators

(*Continued from page* 94)

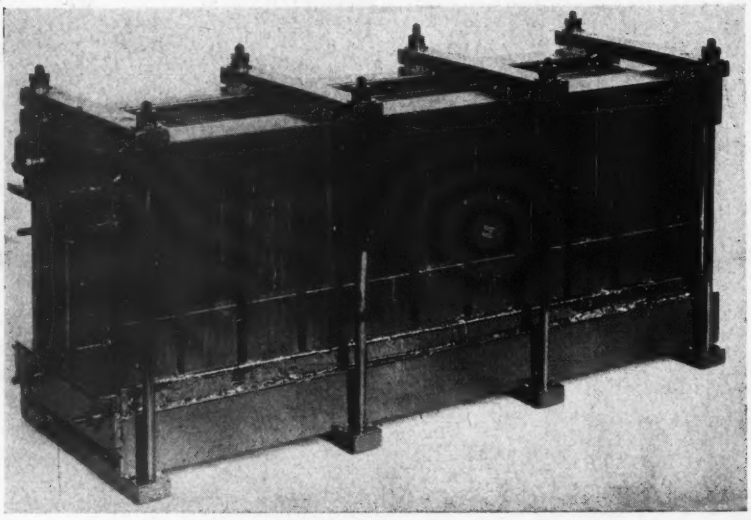


Fig. 4. The type of reactor used in balancing reactances between bus bars

what should be done about it. One possible solution would be to change the construction of the leads to obtain balanced reactances, as by spacing the leads at equal distances from each other, forming a triangular arrangement. Changing the construction of existing leads was, however, found to be a costly procedure.

The solution adopted consisted, simply, of putting reactance in series with the middle phase of the leads of each generator. The reactor used reduces the current in this phase to a value equal to that in each of the other two phases.

This type of reactor is shown in Fig. 4 and a cross-section of it in Fig. 3, the latter illustrating its location as installed in the generator leads. The reactor has no terminals or winding. It consists of iron laminations which surround the copper bar or bars of the middle phase of the leads. Clamps hold the laminations in place. The reactor, which may be supported by hangers or brackets, is built in a number of sections to facilitate adjustment of the reactance, if required. Each section is made up of L-shaped punchings placed as shown in Fig. 3. Hence, sections may be added or removed without touching the generator leads.

When installed, the first reactor produced a very satisfactory balance of the currents of the generator for a large textile mill. Since that time, two other plants have installed these reactors. In one case, the unbalances were partly due to the construction of the main bus and the feeder circuits, as well as the generator leads. Since the plant load was practically constant, it was found satisfactory to use reactors in the generator leads to correct unbalances due to the buses and feeder circuits as well as due to the leads themselves.

There are undoubtedly other plants which could profit from the use of such reactors to correct troublesome current unbalances, and thus permit generator operation at maximum output.

A Look at the Nation's Coal Pile

(*Continued from page* 85)

7. Use as little air for burning the fuel as possible without making smoke.
8. Prevent unburned fuel in the ashes as much as possible.
9. Stop all undesirable air leaks in the boiler setting.
10. Keep all gas passages through the boiler clean.
11. Keep furnace brickwork and baffles in good condition.
12. Keep breeching and chimney free from obstructions.
13. Blow down the boiler as little as possible.
14. Keep equipment and piping free from steam and water leaks.

Engineers will find it helpful to keep in close touch with the local representatives of the National Fuel Efficiency Council known as Coordinators, Regional Engineers, and "Waste Chasers." At the present time, information pertinent to equipment, supplies and modern power plant practices developed by the Bureau of Mines in conjunction with industrial groups has been passed on by these chosen experts for use in the NFEC program and is available to fuel users. Plans are being made to cover about 100 subjects but there is now available special information on the following: Coal handling and storage; combustion; boilers (all types and capacities); stokers (industrial and commercial); gas and fuel oil in commercial and industrial applications; instruments—control, recording, measuring; heat utilization and distribution; fans, filters, air recirculation and purification; insulation; exhaust steam utilization; and control of miscellaneous energy losses.

Not only has the NFEC made this valuable information available but this group is organized to advise owners and operators, immediately and without cost, regarding suggested measures to combat waste.

This fuel efficiency program also includes the distribution of questionnaires and check sheets aimed at securing information that can be used to advantage in other plants throughout the country, and at assisting operators in inspecting their fuel burning equipment.

One of the subjects being studied is the action of coal in storage. In this the engineer is asked detailed questions regarding the identification and source of the coal being stored, the condition of coal when stored, the conditions of storage, and the storage experience.

The check sheets prepared are individual forms applicable to all types of combustion equipment and boilers, asking detailed questions regarding the condition of equipment, the results secured and making suggestions intended to inform the engineer regarding the most efficient modern methods of boiler operation.

Another service is a series of fuel efficiency letters which are being prepared by Joseph Harrington giving pertinent information on coal and its uses. Among the subjects treated are soot blowing, furnace capacity, hand firing methods, overfire air and smoke. Many valuable suggestions are made in this series of letters which are being issued weekly to managers of coal using plants in the Chicago area.

Fuel users of the country are presented with the problems of reducing fuel requirements without impairment of the health of the people or the productive capacity of industry. This is indeed a challenge to the engineering profession and, regardless of whether or not a fuel crisis with its accompanying ill effects on the nation's welfare occurs this coming winter, much will be done in the way of demonstrating the feasibility of employing numerous known but little used methods of saving fuel, the benefits of which will continue on into the years to come.

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Do Bacteria Cause Condenser Tube Corrosion?

Here is a new line of thinking on the possible cause of condenser tube corrosion in "fresh water" power plants. Work done by the author and other investigators indicates that beyond the mineral analysis of fresh water may lie the real cause of the trouble. Groups of bacteria, in the presence of certain other substances, may produce hydrogen sulphide, ammonia and nitrogen compounds, which can attack copper and zinc in condenser tube metal. Here is a possible answer for some of the less-readily-explained condenser tube failures

By JOHN M. DRABELLE

Consulting Engineer, Iowa Electric Light & Power Co.

THE OBJECT of this paper is to suggest to you a new line of thinking and, perhaps, to your chemists a new line of approach and research on the troublesome and expensive problem of condenser tube maintenance in surface condensers in large power stations located in the so-called "fresh water" territories served by the Missouri Valley Electric Association member companies.

For many years this problem has been a perplexing one. There has been much discussion as to what causes condenser tube failures. The usual contributing causes are: deposits of debris such as coke, gravel, bits of wood in the tubes themselves, causing local points of corrosion or erosion; high water velocities, and entrained air, particularly at the entrance to the tube have caused impingement erosion or corrosion; but there has been a large group of tube failures, particularly involving the relatively short life of Muntz metal tubing and the longer life of Admiralty tubing and later the new alloys to which there was not much of an answer.

Straub says, "This attack is commonly referred to as dezincification. The beta metal in the brass has the zinc removed and the copper remains as a spongy mass of very low strength. This method of attack rapidly goes through the tube. It is very difficult to detect until the tube is almost worthless."

Various text books on the surface condenser, principally books published in England, deal at length with the experiences of the British Admiralty with condensers aboard ship, and the history of the development by the British Admiralty of a metal particularly resistant to corrosion. Two facts seemed to stand out in all publications:

(1) that the vessels having condenser tube failures were usually in the tropics with warm circulating water, and

(2) in harbors, the water of which was highly polluted or contaminated with organic wastes and sewage.

Our own experience with various condenser tube materials confirmed this. Our circulating waters are as a rule warm in the summertime and are highly polluted and contaminated.

As to fresh water, there is a complete lack of definition. Our rivers and lakes are commonly regarded as fresh water. They were, at least in pioneer days, but today this water is highly polluted and contaminated by large quantities of various organic materials, raw sewage, barnyard drainage, sewage disposal plant effluent and industrial wastes. Obviously, filtration and treatment are required before the water is fit for human consumption. This untreated water is the so-called "fresh water" that circulates in our surface condensers.

With surface condensers taking their waters from certain sources, it was natural that the tubes rapidly fouled with slime deposits, thereby materially reducing the rate of heat transfer.

One of the unpleasant jobs around a power station was that of cleaning condensers that had fouled in this manner. This was usually accomplished by the use of high-pressure water jets, rubber plugs and wire brushes. Each tube held a quantity of mud and other material of about the consistency of jelly.

Apparently the first use of liquid chlorine for desliming of condensers was reported in the Electrical Times of London, issue of June 1922. L. L. Robinson of Hackney, England, recognized that the glutinous and clinging mud, which had a disagreeable smell and assumed the consistency of jelly, obtained its characteristics because of micro-biological phenomena. At the suggestion of Sir Alexander Houston of the Metropolitan Water Board, Mr. Robinson initiated the chlorination of central station surface condenser circulating water.

In 1924 A. E. Grunert of the Commonwealth Edison Co. of Chicago, together with Wallace and Tiernan Co., Inc., instituted experimental work at Northwest Station to check the American applicability of Robinson's recommendations. Following this pioneering work of Grunert, the chlorination of circulating water for the removal of slimes and the maintenance of high heat transfer rates in surface condensers became standard American practice. This work has been variously reported in the reports of the Prime Movers Committee of the Edison Electric Institute, the Operating Committee of the Association of Edison Companies, and the American Society of Mechanical Engineers.

The attack upon the metal of the tube can therefore be stated to be of a character initiated by bacteria or products of decomposition of bacteria or algae. The film of water immediately adjacent to the metal itself is at a higher temperature level than the circulating water, even under turbulent flow through the tube. Various types of bacteria have various temperature levels at which they are either killed or become extremely active, and with the temperatures that exist in circulating water under summer conditions, the environment is ideal. The process may be that of adsorption through the action of thermophyllic types of bacteria.

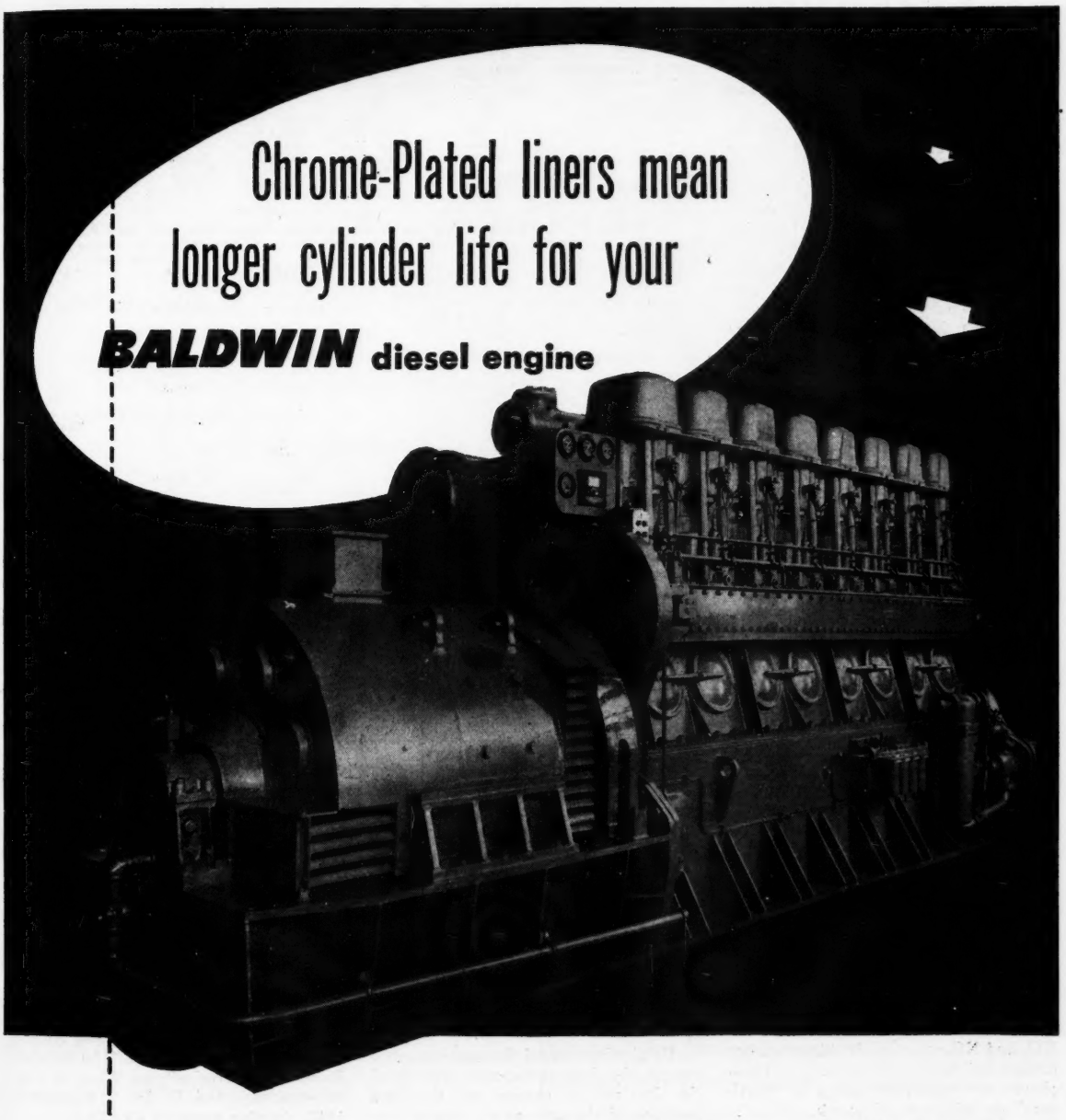
Ordinary mineral analyses of the various injection waters gave no answer. There was nothing that indicated definitely any particular mineral chemical situation to cause the failures experienced. In 1917, we definitely abandoned Muntz metal (60 per cent copper, 40 per cent zinc) as a condenser tube material, selecting Admiralty metal as a hoped-for solution. The Admiralty metal, under the conditions present, again referring to the British Navy and its experience, performed satisfactorily. Many surface condensers have had a tube life with Admiralty tubing as much as 20 yr, whereas with Muntz metal failures began within the first operating year, and practically 100 per cent replacement was necessary within 2 to 3 yr from the date of initial operation.

This paper is not intended to present a proof of a theory, but to suggest to you a somewhat different line of thinking, investigation, and possible research along rather unusual bio-chemical lines of thought as to wherein a possible answer to condenser tube failures may be found.

Again referring to the matter of mineral analyses of water, this revealed nothing. However, there were certain chemicals that are reported as traces, principally ammonia. Ammonia (NH_3) is the resulting by-product of organic decomposition. The odor of ammonia around a barnyard is illustrative. Likewise, in waters that flow over water courses containing extensive deposits of gypsum rock, this being chemically calcium sulphate ($CaSO_4$), calcium sulphate did predominate and was a considerable part of the mineral analyses, and in waters containing the effluent of sewage disposal plants, the growth of certain algaes and bacteria are accelerated.

Having done some work for and with the Iowa State Conservation Commission, the Iowa State Board of Health, and having a friend who is a recognized authority in the construction of sewage disposal plants, I began to have some picture of the corrosion problem around sewage disposal plants, and the character of the effluent from such plants; and, with the men of

Abstract of paper delivered April 6, 1944 before Missouri Valley Electric Association and Prime Movers Committee at Kansas City, Mo.



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the State Board of Health and the Conservation Commission, some ideas as to the biological activities that take place in streams, lakes and ponds when certain chemical compounds as well as certain biological products are present.

This led to some thinking along the lines of bacterial action when certain other chemicals were present. There is a group of bacteria which, when a sulphate is present, will convert those sulphates to hydrogen sulphide (H_2S). Likewise, there are algaes, principally of the blue-green types, and certain types of nitrifying bacteria that in the presence of sewage disposal plant effluent or organic sewage, convert those products into nitrogen compounds such as nitrite (NO_2), nitrate (NO_3), and ammonia (NH_3).

Dr. Ben H. Petersen makes the following comment: "The nitrifying bacteria are probably more responsible for the nitrogen cycle (i.e. the process ammonia to nitrite to nitrate) than are the algae. This type of bacterial action is a normal process by which organic wastes are rendered fit for reuse by plant life. The action of the oxygen which probably originates exclusively from air, is very probably not 100 per cent efficient. Assuming 100 per cent efficiency, some calculations are interesting:

"For complete oxidation, 1 ton of ammonia will require 4.25 tons of oxygen. This is a tremendous volume."

An examination of the electro-chemical series involving metals such as copper, zinc, tin, arsenic, antimony, and phosphorus with hydrogen sulphide, ammonia and nitrates and nitrites as an electrolyte reveal a rather active electrochemical situation. Table I gives the composition of several representative condenser tube metals.

It is a well-known fact that copper in the presence of hydrogen sulphide forms a black film of copper and sulphur, CuS, which is fairly resistant to attack as long as the water has a pH above 7. It is a well-known fact that zinc is peculiarly susceptible to attack of hydrogen sulphide, ammonia and nitrogen compounds such as NO_2 and NO_3; the tin, the higher copper content and the arsenic antimony or phosphorus are apparently acting as "fortifiers" or inhibitors of attack. Here, in the opinion of the writer, lies a possible answer for some of the less readily explained condenser tube failures in so-called "fresh water."

An analysis of water for condensing purposes at several sources is shown in Table II.

It will be noted from Tables II and III that the Cedar River is a particularly clean stream, largely due to a comparatively large flow of water with a high dilution factor for organic materials, reducing them to quantities practically undeterminable. On the other hand, Cedar Lake shows a very high contamination or pollution with resulting end products, and the Iowa River, a very small stream having a very low rate of flow shows a very high rate or contamination/pollution factor due to low dilutions.

The bio-chemical demand is a means of measuring the intensity of pollution or the presence of oxygen consuming materials. The procedures for this are set forth in "Standard Methods of Water Analyses," consisting briefly of taking a sample of the suspected water, saturating it with air, and then daily determining the amount of oxygen consumed. Bacteria or algaes of the types present require oxygen to live, and consequently if the water is highly polluted, the oxygen is very quickly used up. A typical analysis of the presence of oxygen consuming material is given in Table III.

By plotting elapsed time and consumed oxygen, the slope of the curve will reveal the time rate of change, and this is a measure of the amount of oxygen consuming material present in the sample. Obviously, the higher rates of absorption of oxygen show pollution or contamination.

It is obvious that if a water sample is taken in the wintertime, due to the low temperature of the water the rate of life growth of bacteria is at a very low level. Conversely, it is true that in summer with high temperatures prevailing, approximating body temperature, then the rate of life growth is extremely rapid. Determinations of the B.O.D. cycle of a stream or lake show that this varies in the ratio of 1 in the wintertime, with temperatures approximating 34 F, to 20 in the summertime, with temperatures approximating, say 90 F, i.e., the warmer the water, the greater the bacterial activity and oxygen demand.

Cooling towers are not free from these phenomena as windblown dusts contain bacteria, thus "seeding" the circulating water and the same condenser tube failure characteristics have been noted by us on cooling tower waters.

There is much corroborating evidence to support this theory. Reference is particularly made to the condenser tube manual of the Bridgeport Brass Co., pages 37 to 62, inclusive, issue of 1943. The Surface Condenser by B. W. Pendred, published in London by Sir Isaac Pitman and Sons, Ltd. A paper by Dr. Arba H. Thomas, Chief Research Chemist, American Rolling Mill Company, "The Role of Bacteria in Corrosion"; see Water Works and Sewerage, Vol. 89, No. 9, September 1942. Another paper by Dr. Thomas entitled "The Role of Bacteria in the Corrosion of Iron and Steel." A paper by W. J. O'Connell, Jr., of the Technical Division of Wallace and Tiernan Co., Inc., delivered before the American Petroleum Institute at their 11th Mid-year meeting, "Characteristics of Micro-biological Deposits in Water Circuits." Such is the technical literature available on this subject which seems to lend proof to the theory that beyond the mineral analysis of fresh water lies an answer to condenser tube failures in so-called "fresh waters."

Copies of this paper were sent to various men of the industry who are familiar with the problems of surface condensers and condenser tube maintenance. Their comments on the whole, indicated a feeling that the above ideas merited serious consideration.

TABLE I. Condenser Tubing Composition

Chemical Composition	Muntz	Admiralty	Arsenical Admiralty	Aluminum Brass	Phosphor. Admiralty
ASTM Specifications	B-111-42	B-111-4	B-111-4	B-111-42	B-111-42
USN Specifications	.....	44-T-7-F	44-T-7-F	.....	44-T-7-F
Type	.....	"A"	"B"	"B"	"D"
	%	%	%	%	%
Copper	59.00/63.0	70.0 Min	70.0 Min	76.0 Min	70.0
Lead	0.3 Max	0.075 Max	0.075 Max	0.075 Max	.....
Iron	0.07 Max	0.06 Max	0.06 Max	0.06 Max	.....
Zinc	Remainder	Remainder	Remainder	Remainder	29
Tin	.....	.90/1/20	0.90/1/20	.....	1.0
Arsenic	.....	.....	0.10 Max	0.10 Max	.....
Aluminum	.....	.....	.....	1.25/2.5	.....
Phosphorus	.....	.....	.....	.....	0.01/0.07

TABLE II. Comparative Analysis of Cedar River, Cedar Lake, and Iowa River

Location		Cedar Rapids		Iowa Falls	
		Cedar River ppm	Cedar Lake ppm	Iowa River 8-21-41	Iowa River 12-29-43
Time of Sampling		Summer	Summer	Summer	Winter
Calcium	Ca	55.	50.	70.5	128.
Magnesium	Mg	17.	13.	30.5	36.
Sodium	Na	11.	23.	66.1	33.
Iron and Alum.	Fe Al	0.	0.	1.6	1.1
Silica	SiO_2	11.	4.	10.6	19.0
Bicarbonate	$(HCO_3)_2$	222.	117.	260.8	461.
Sulphate	SO_4	32.	110.	71.8	78.4
Chloride	Cl	9.	12.	4.0	3.8
Ammonia	NH_3	....	.01	.10	Trace
Nitrites	NO_2	....	.05	.05	.70
Nitrates	NO_3	....	.10	.10	1.2
Total Dissolved Solids		244.	269.	385.0	
pH.		7.6	7.3	7.4	8.2
Suspended Matter				large	40.0
Organic and Volatile				large	192.0
Analyst		Petersen	Petersen	Straub	Petersen Pack

TABLE III. Bio-Chemical Demand Expressed as O_2 in ppm—Analyst Dr. Ben H. Petersen

Source	Cedar River	Cedar Lake	Iowa River
Time of Sampling	Summer	Summer	Winter
Temperature Sample Held	20.0 C	20.0 C	20.0 C
Days 1	11.2	9.60	
" 2	9.6	7.30	
" 3	7.8	5.80	
" 4	7.6	5.16	
" 5	7.2	4.30	
" 6	....	....	
" 7	....	2.0	
B.O.D. in O_2	4.0	7.6	1.17
Days	5	7	5

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2 If your teeth ache,
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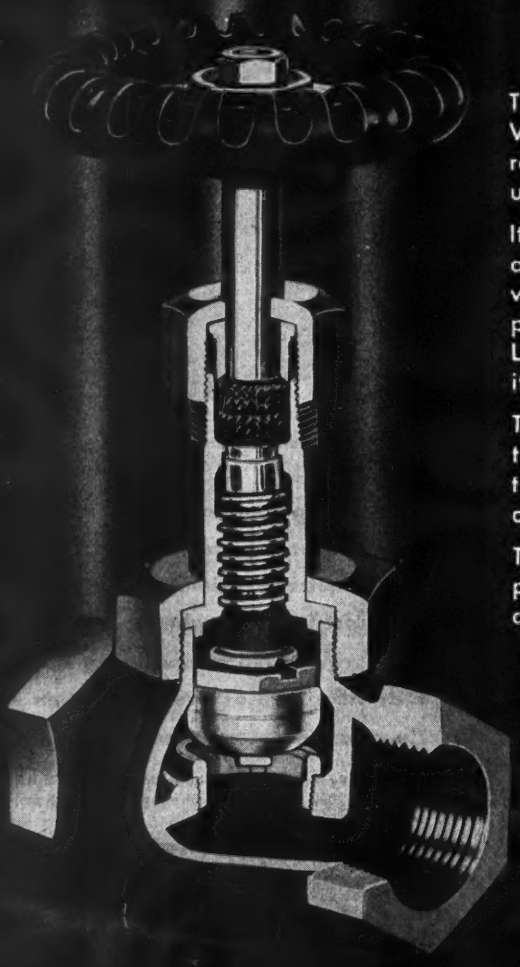

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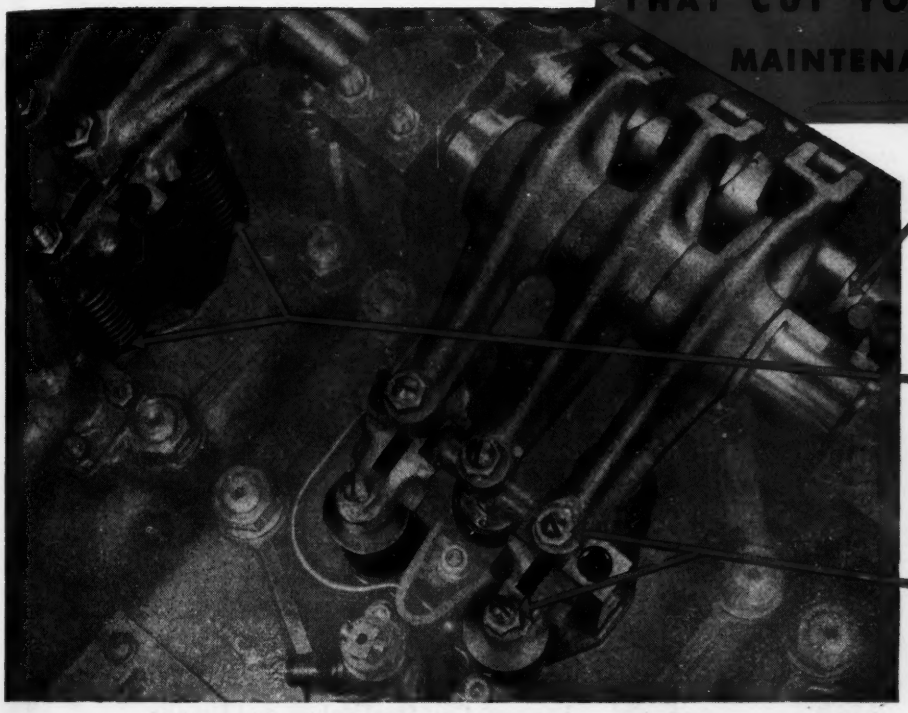

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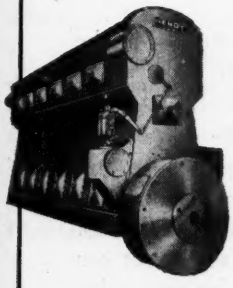

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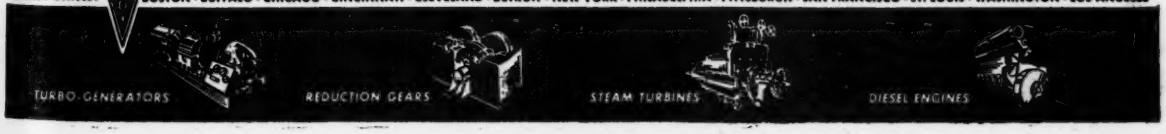

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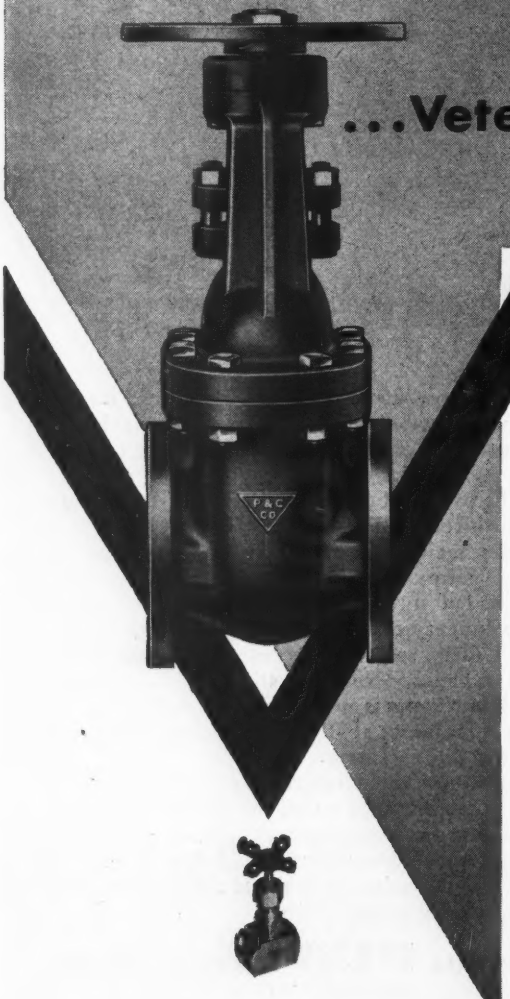

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D'ESTE Valve and Engineering Specialties since 1870 . . .

. . . veterans all. Yes, and pioneers—in the development of improvements to make valves function better, last longer, serve more efficiently and at lower over-all cost.

Thus, as a manufacturing organization, Reading-Pratt & Cady has long and *specialized* experience in the making of good valves. Moreover, Reading-Pratt & Cady serves you as a single responsible source for your valve requirements.

READING-PRATT & CADY

MANUFACTURERS OF

READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

ACCO

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

A CHOICE THAT CAN BE IMPORTANT

MIDWEST "STANDARD" BUTT-WELDING ELBOW

MIDWEST "LONG TANGENT" BUTT-WELDING ELBOW

. . . . and ONLY MIDWEST offers THIS CHOICE

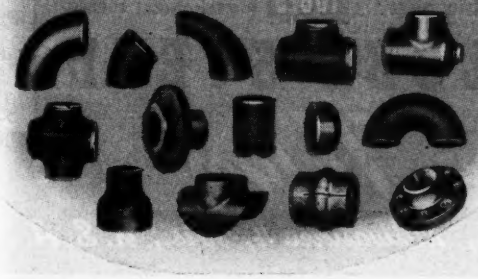
Before you select welding elbows to use on any given piping job, it will be worth your while to consider the relative values of the two elbows shown. On some jobs the correct selection can mean a real saving of time and money. Only Midwest offers you the choice of either type elbow . . . and there is no difference in price.

The "American Standard" elbow has a center-to-end dimension equal to one and one-half times the nominal pipe size. The Midwest "Long Tangent" elbow has a center-to-end dimension of one and three-quarters times the nominal pipe size; it has tangents (straight ends) equal to one-fourth of the nominal pipe size.

These long tangents make it possible for pipe and fitting to be lined up more quickly and accurately. Less pipe is required, a short nipple and an extra circumferential weld are frequently eliminated, and slip-on welding flanges are more easily used.

Both elbows have all advantages of the unique Midwest manufacturing process: final working of the metal in compression (which means exceptional dimensional accuracy and uniformity), stress relieving, exact included angle, true circular section and uniform wall thickness.

MIDWEST
WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



MIDWEST
PIPING & SUPPLY COMPANY, INC.
Main Office: 1450 South Second St., St. Louis 4, Mo.
Sales Offices: New York—(Eastern Division) 30 Church Street
Chicago—645 Marquette Bldg. • Los Angeles—520 Anderson Street
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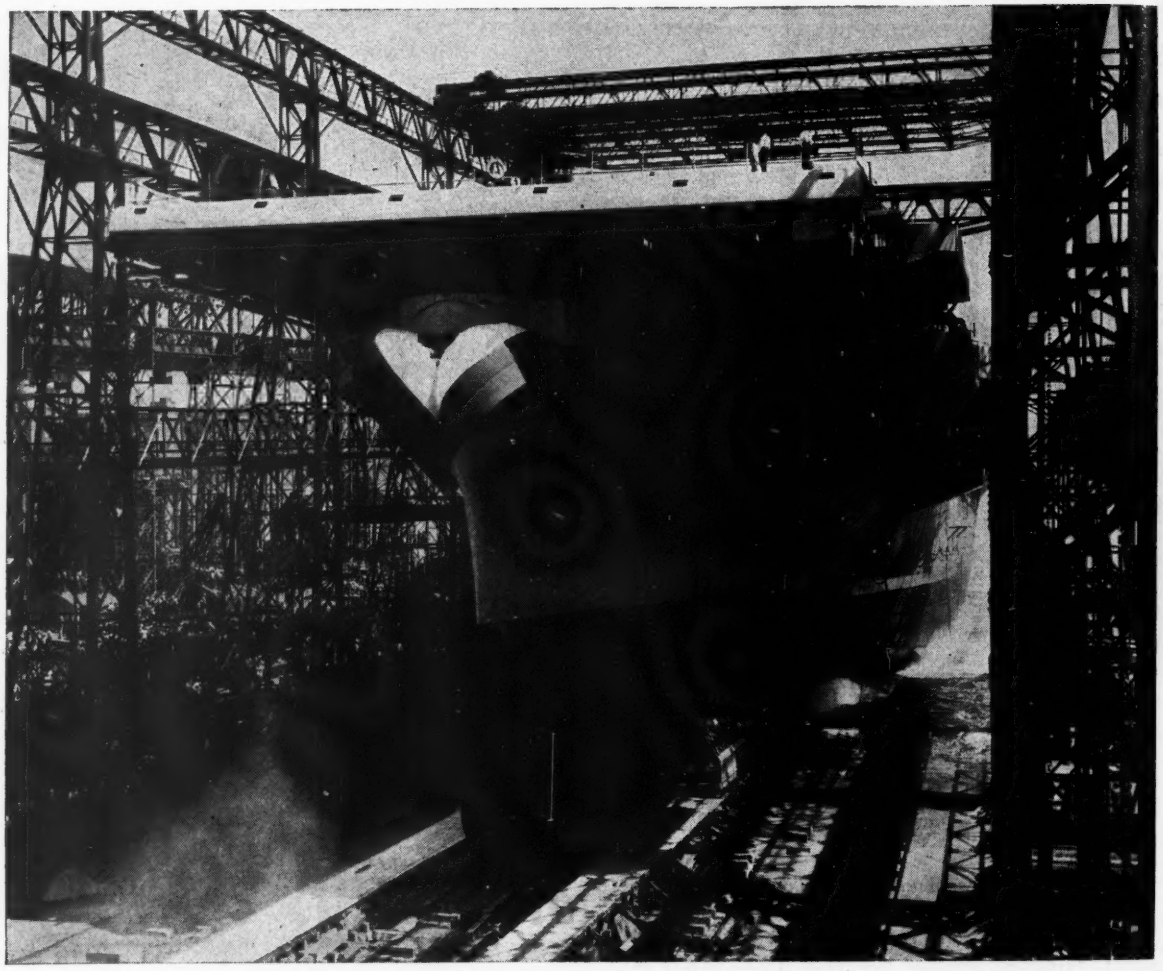
426 First St. • Atlanta—Red Rock Bldg. • Distributors in Many Cities



A New U.S.S. Wasp, Aircraft Carrier, goes into the water...

Many U. S. warships, battleships, aircraft carriers, and smaller craft are equipped with a considerable "mileage" of Globe Seamless Steel Tubes . . . for boiler tubing, steam lines, water lines, compressed air lines, etc.

Globe Seamless Steel Tubes are made in a wide range of sizes and wall thicknesses to act as "arteries and capillaries" carrying fluids and energy to all parts of the ship.

• • •

Globe Engineers will be glad to work with you on any steel tubing problems, large or small.

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

GLOBE TUBES

★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL *Tubes*

5010

GLOBE STEEL TUBES CO., *Milwaukee 4, Wis., U.S.A.*

DOWELL INDUSTRIAL CHEMICAL CLEANING SERVICE

WHERE YOU WANT IT—

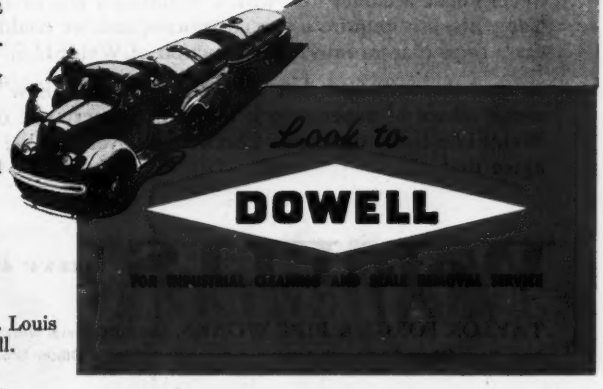
When the vital productive capacity of your power plant has been reduced by water- or steam-deposited scales and sludges, call for Dowell mobile unit service for rapid economical restoration.

WHEN YOU WANT IT!

Complete with required chemicals and scale-analysis equipment in charge of trained personnel, a Dowell unit is ready to roll to the scene at your appointed time. Correct solutions, prepared after complete analysis of the deposits, are forced by automotive pumps to all heat exchange surfaces.

This safe, effective method, involving no plant dismantling and a minimum of down-time, is a significant development of Dowell in cooperation with its parent organization, The Dow Chemical Company.

Make a date for *more power!* Get in touch with the nearest Dowell office.



DOWELL INCORPORATED

529 Kennedy Building Tulsa 3, Oklahoma

New York • Philadelphia • Cleveland • Chicago • St. Louis
Kansas City • Houston • Long Beach • Salem, Ill.
Mt. Pleasant, Mich. • Wichita, Kan. • Casper, Wyo,

IT'S NOT THE USUAL THING TO DO—

*Taylor Forge was the first, and is still the foremost, manufacturer of forged and rolled steel welding necks, nozzles and channel sections. An unusual and interesting forging of this kind is the blind channel section with side openings illustrated above.

You can be sure that in these crowded days we are not seeking unusual forging assignments. Our sole purpose in citing this, and similar out-of-the-ordinary jobs, is to point out the vital influence of this special experience on our regular products.

Yes, over the years we have been called upon to perform so many special forging operations that the unusual has, in a sense, become the usual here at Taylor Forge. And there is no better example of this than the *special* operations which contribute extra value to our *regular* line of WeldELLS and other Taylor Forge welding fittings.

Special steps are necessary to attain the uniform strength achieved in WeldELLS through proper distribution of extra metal where stresses are greatest. A special truing operation accounts for the extreme dimensional accuracy for which WeldELLS are so favorably known. Tangents, too, require a special process, and we could cite many more extra steps that go into the production of WeldELLS.

In fact, you will find that Taylor Forge "know-how" acquired in the tough school of experience is reflected in every one of the features of WeldELLS listed opposite. Check them over and we believe you will agree that . . .

WeldELLS alone combine these features:

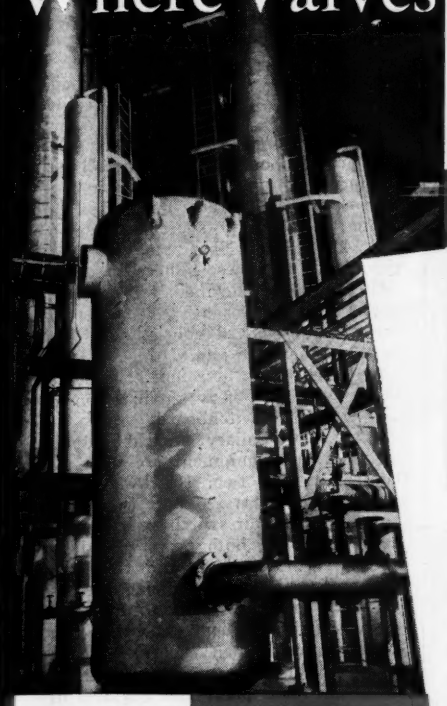
- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

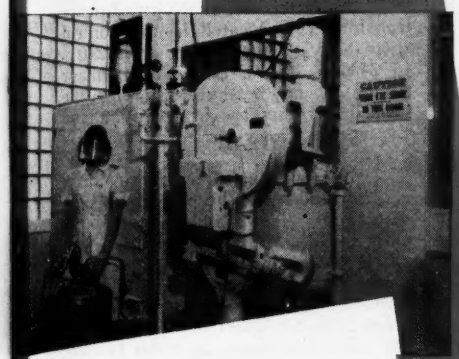
WeldELLS have everything

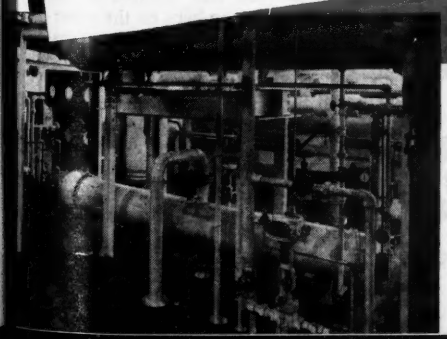
TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

Where Valves control *Life* - for Millions

PENICILLIN'S first large-scale producers rely on the proved merit of Jenkins Valves







COMMERCIAL SOLVENTS CORPORATION

TERRE HAUTE, INDIANA

August 10, 1944.

Mr. R. B. Osgood, Manager
Jenkins Bros.
1514 West Fulton Street
Chicago 7, Ill.

Dear Mr. Osgood:

Thank you for your letter of August 8, with reference to the "LIFE" magazine article on Penicillin, which described our new plant.

The Jenkins Valves which appear so frequently in the illustrations have played a creditable part in the successful operation of the plant at better than rated capacity.

About two out of every three valves in the plant are Jenkins Valves, 1673 in all. This percentage is highly significant, especially since we required many special valves which you do not make. We used a wide variety of Jenkins Valves -- steel, stainless steel, and bronze, in sizes from 1/8" to 12".

Our approval of Jenkins Valves for many of the critical services in this vital new plant was prompted by their service record in other plants of Commercial Solvents Corporation, where their performance has been completely satisfactory, both in peacetime, and under severe conditions of war production.

Very truly yours

COMMERCIAL SOLVENTS CORPORATION

M. C. Wheeler

M. C. Wheeler
Production Manager

MCW-md

1673
Jenkins Valves
provide dependable control points in miles of complex piping

Dependable control of the fermenting, centrifuging, refrigerating, high vacuum, and other special equipment is absolutely essential to maintain full production, and output is already exceeding the goal. The many Jenkins Valves used match the efficiency of the complete plant, which has been repeatedly declared by experts to be a "modern industrial miracle".

The world's first large scale plant for Penicillin production, operated by Commercial Solvents Corp., is more than a brilliant technical achievement. It is the hope of fighting men and civilians everywhere, who, denied the healing magic of Penicillin, would have been condemned to suffering and death.

The operation of every bit of equipment in the plant has a direct bearing on the speed with which Penicillin can be made. That is why valves, like all equipment, were chosen on the basis of proved performance.

The proved dependability of Jenkins Valves, so important here to operations, is an equal advantage in low maintenance -- the reason why Jenkins "cost least in the long run". Specify Jenkins Valves in your plans for reconversion and renovation.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros. Ltd., Montreal; London.

JENKINS VALVES

SINCE 1864

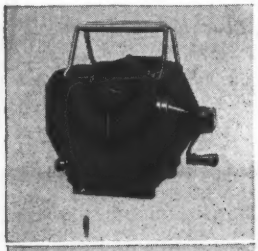
For every industrial, engineering, marine and plumbing-heating service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.

Sold Through Reliable Industrial Distributors Everywhere

with "MEGGER" INSULATION TESTING INSTRUMENTS

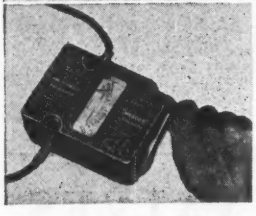
Today's heavy demand on every type of electrical equipment makes maintenance a matter of vital importance. Regular check tests of the insulation on motors, cables, controls and other electrical apparatus will save priceless time through the detection of incipient failures and the application of corrective measures.

Make sure that you have a "Megger" instrument and that it is used regularly and frequently. Minutes with the "Megger" tester can save days of delay. If you are not aware of the protection afforded by the use of "Megger" instruments and their importance in keeping electrical equipment in operation, write for the Pocket Manual of "Megger" Practice, No. 1420-PE.



THE NEW U. S.-MADE "MEGGER" INSULATION TESTER—Consists essentially of a direct-reading true ohmmeter of the permanent magnet moving coil type mounted with a d-c hand generator in a plastic molded case. Ranges up to 1000 megohms, with hand generators up to 500 volts. Widely used in hard service. Variable-pressure ("Meg") and constant-pressure ("Super-Meg") types. Bulletin 1735-PE.

THE "BRIDGE-MEG" RESISTANCE TESTER—This instrument is a combined "Megger" Insulation Tester and a four-dial, multi-ratio Wheatstone Bridge. Will measure any ohmic resistance from .01 ohm up to 100 or 200 megohms; hand generators rated up to 1000 volts. A complete and compact resistance measuring unit that is ideal for power companies and industrial plants. Catalog 1685-PE.



THE MIDGET "MEGGER" TESTER—In many ways the most remarkable "Megger" instrument ever built. Weighs only 3 lbs.—will fit an overcoat pocket or tool kit. Reads up to 50 megohms. Generates 500 volts and is always ready to use anywhere because of the hand crank. Send for Catalog 1690-PE.

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

The Barge "ELECTRA"

(*Continued from page 87*)

with an outside source. Totalizing indicating watt meters, ammeters, graphic demand meters, and watt-hour meters are provided. Three voltmeters are also provided on this panel to indicate ground condition on the 2400 v bus. One other panel is provided for paralleling the auxiliary switchboard with the 2400 v bus. This panel has synchronizing facilities. There are two switchboards. The main switchboard, above described is set thwartship, while the auxiliary board consisting of six panels, is set fore and aft on the starboard side, with a five foot clear space between the end of the auxiliary board and the main switchboard.

On the auxiliary switchboard all switches and equipment are built for controlling the two, 150 kw, 240 v, 3-phase generators. There is also a complement of air switches serving the several feeders, both power and light throughout the plant, and the usual instruments for synchronizing the machines. Provision is made to utilize the output of the auxiliary generators as a power supply when the main generators are shut down and also to parallel with the main plant and augment its output in emergencies. To make possible this latter use, a 300 kw, 3-phase transformer is located in the control room to boost the voltage from 240 v to 2400 v. Thus, also, the auxiliary generators may be shut down when the main generators are in operation and the auxiliary load carried on the main plant.

In the selection of main transformers, reliability was the paramount consideration. Weight and space did not enter into the picture. Three 2000 kva, single phase, oil insulated, air cooled transformers were located outside the structure. These boost the bus voltage from 2400 to 12,000 v for entry into the submarine cable. In order to obviate failures which might result from exposing high tension bushings to salt water and salt spray, both primary and secondary bushings were brought out into watertight terminal chambers for metallic bus duct connections. The 2400 v bus duct is completely watertight and terminates at an external disconnect in the rear of the main switchboard. The 12,000 v bus duct terminates through the usual disconnects in the watertight housing of the 12,000 v oil switch.

To obviate stresses and strains resulting from the rolling of the barge, transformer and oil switch structures were rigidly braced between one another at the top and secured to the main structural members of the superstructure. The bottoms of the transformers are securely bolted to a seating, welded to the barge deck and compensated for deck camber.

Communications throughout the plant are made by sound powered telephone, connecting the cabins of the plant engineer, and chief electrician, the radio room, machine shop, main engine

KENNEDY
BRONZE GATE VALVES

Figure 27
Standard, Screwed Ends

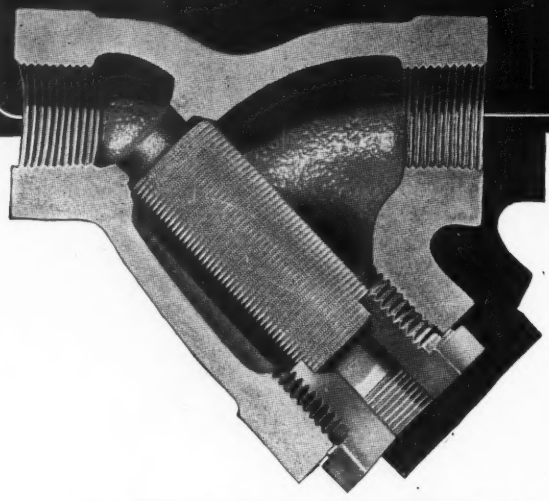
Simple
Sturdy
Durable

Assure easy operation, and lastingly trouble-free service. Available in non-rising and rising stem types; also outside screw and yoke. Built for steam pressures up to 300 lbs.

Buy From Our Distributor

THE KENNEDY VALVE MFG. CO.
ELMIRA, N. Y.

It says
"STOP" to Solids—
"GO" to Fluids

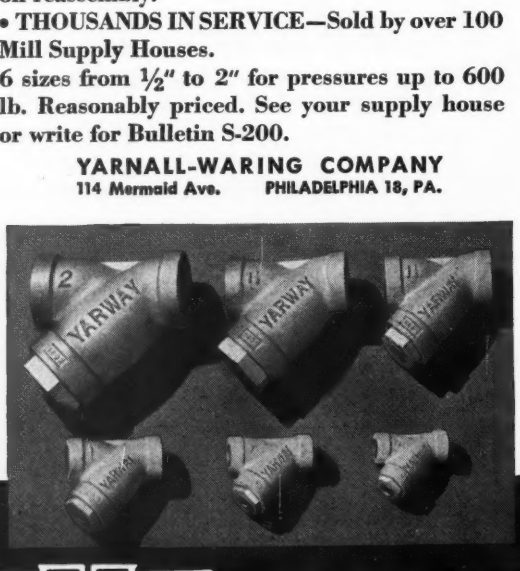


A BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.
- **SECOND**—*Finish*. Cadmium plated inside and out for protection against corrosion.
- **THIRD**—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.
- **THOUSANDS IN SERVICE**—Sold by over 100 Mill Supply Houses.

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-200.

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.



YARWAY STRAINERS

room and switchboard control room. There are also phone receptacles located near each generating unit so that the engineer on watch, by using a battle type head set and microphone, may communicate directly with the control room. Communications with shore or other locations of power demand which may be served by the plant, are made by radio-telephone with connections in the radio room and switchboard control room.

The auxiliary equipment of this plant differs but little from any other ship's complement, except that there are four motor driven anchor winches located at the four corners of the barge. The use of four anchors restrains movement of the operating barge, that might otherwise place heavy mechanical strain in the submarine cable. The usual fire pumps, sanitary pumps, bilge pumps and fresh water pumps, all are included in the auxiliary equipment. Tank storage for 7000 gal of culinary water is provided in addition to two electric water stills capable of furnishing 1400 gal a day. An additional fresh water storage of 41,000 gal is provided for washing purposes. This storage may be renewed from barge or from shore. The systems are interconnected for emergency use.

High voltage conductors throughout the ship are of varnish cambric, lead covered and basket-weave armored. All are carried in rectangular metal raceways. All cables are single conductor, so chosen to reduce terminal stresses. Large secondary cables are of the same type of construction. The balance of the lighting cables throughout the ship are synthetic insulated, lead covered and basket-weave armored.

Fire fighting equipment consists of CO_2 gas and Pyrene. A complete set of this apparatus is installed at each hatchway to the hold. Above decks are ten high pressure water hose connections supplied by fire pumps.

There is a galley and mess accommodations. Quarters are provided for the regular crew with additional bunk space for the crews of dredges or other power users with which this plant may be working.

In announcing the construction of this plant, Colonel Robert C. Hunter, Sacramento District Engineer for the United States Engineers, emphasized the point that whereas all electrical equipment of this barge was designed and installed under the direction of the Sacramento District Office, the ship itself was constructed at San Francisco under the direction of the Pacific Division of the United States Engineers.

Unit 17 at Fisk Station

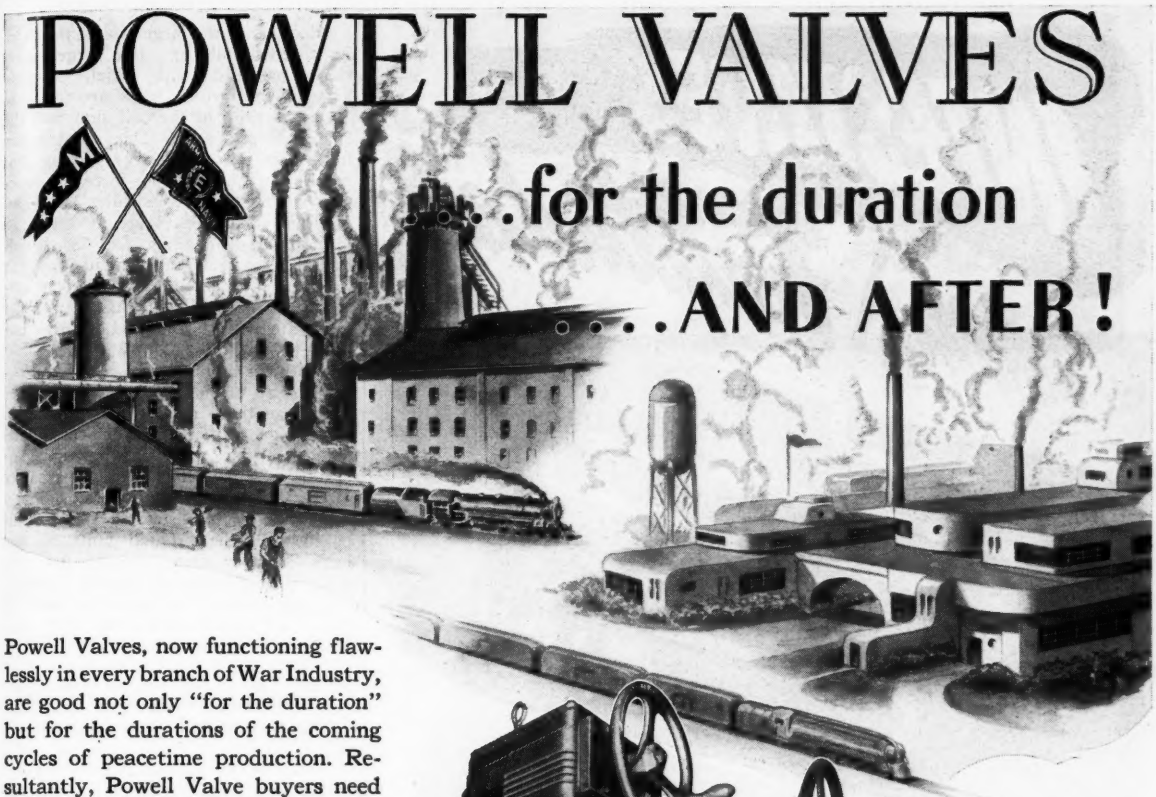
(*Continued from page* 93)

watts and amperes, its armature has two electrically independent windings, each of which connects to a separate bus system. The terminals of the two windings are brought out on opposite ends of the armature to relieve congestion of cables under the machines.

POWELL VALVES

. . . for the duration

. . . AND AFTER!



Powell Valves, now functioning flawlessly in every branch of War Industry, are good not only "for the duration" but for the durations of the coming cycles of peacetime production. Resultantly, Powell Valve buyers need face no scrapped installations when reconversion comes, whether it come by degrees or all at once.

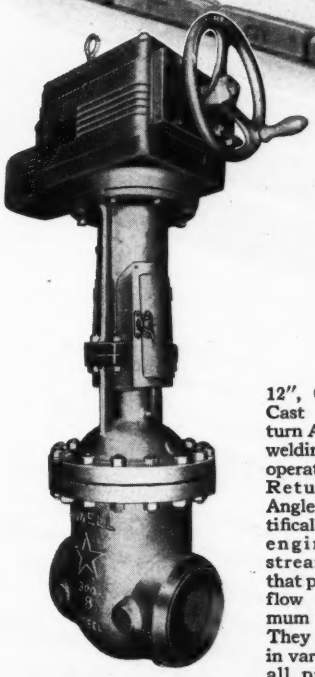
The basic principle of efficient flow control is, at all times, the *right valve,* in the *right spot,* for the *right job.* It is on this principle that the complete POWELL Line of industrial valves of all types and materials has been developed through nearly a century of successful valve manufacture.

The Cast Steel Valves shown here are especially adapted for power plant service. The POWELL Line includes Steel Valves of all types for working pressures from 150 to 2500 pounds and Boiler Feed Line Valves for corresponding pressures.

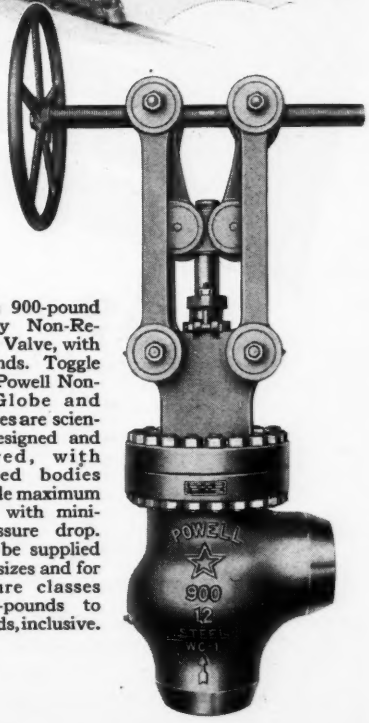
The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio



8", Class 300-pound, Cast Alloy Steel, Welding End Gate Valve. An Electric Motor operator is mounted on top for quick, positive opening and closing.



12", Class 900-pound Cast Alloy Non-Return Angle Valve, with welding ends. Toggle operated. Powell Non-Return Globe and Angle Valves are scientifically designed and engineered, with streamlined bodies that provide maximum flow area with minimum pressure drop. They can be supplied in various sizes and for all pressure classes from 300-pounds to 2500-pounds, inclusive.

POWELL VALVES

INTESTINES with Fortitude!

PTP

Seamless steel tubes are the intestines of the ship, the power plant, the oil refinery, the locomotive, and the chemical plant...delivering an ever-flowing flood of power to America's mighty production efforts.

Seamless steel tube "know-how" is vitally necessary to keep those lines going steadily. Cold drawn seamless steel PTP tubing achieves accuracy to size and uniformity of gauge through exacting control and thorough inspection at every step in manufacture. Where cost is a factor, and seamless steel tubing required, PTP tubing offers an economical and satisfactory solution to the problem.

★ Official United States Navy photograph. Interior of a submarine —a maze of piping.

PIPE & TUBE PRODUCTS
INCORPORATED
Manufacturers of Cold Drawn Seamless Steel Tubing
JERSEY CITY, N. J. • WORKS: READING, PA.

Because of the large size of the field, its core is built up of a forged steel shaft provided with axial, serrated grooves into which teeth are fitted to form the sides of the coil slots and the center of the poles. This construction avoids the extremely large forging that would be required if one-piece construction were used as on smaller machines.

The turbine heat rate at full load is 8750 Btu per kwhr gross. The auxiliary power at full load amounts to about 7,000 kw so that with a boiler room efficiency of 87 per cent the overall net heat rate will be about 11,000 Btu per net kwhr.

With the addition of Unit 17, Fisk—the first all-turbine station in America—marks another important milestone in power generation development. This single machine, with its two steam generators, has more than twice the capacity of the 14 units and 112 boilers originally conceived for the station. When compared with the original units on the basis of floor area occupied the concentration of power is tenfold. Capacity per unit installed has been increased 30 times and performance has been improved 500 per cent.

Unloading Fine, Wet Coal with Material Accelerator

(*Continued from page* 89)

Because of this severe service, a number of alterations were necessary to attain as satisfactory operating results as could be expected, since it was impossible to anticipate entirely the severity of the service.

Based upon about two years of operating experience with this equipment, the following changes in design and construction are being incorporated into the material accelerator now being manufactured for installation at another plant:

The screws for the original operating head were uniformly spaced at 16 in. centers, making it impossible to lower the screws below the center sill of the car. As a result, the coal would hang up on the sloping hopper plate from the top of the sill to the doors, making it necessary at times to remove this coal with hand tools through the doors. Referring to Fig. 1, it will be noted that the screw arrangement has been changed in a manner that will allow the screws to be lowered to the hopper grating at the track level, thereby eliminating the above mentioned operating objection. One of these new style heads is now being installed for the originally installed material accelerator.

The original crane bridge speed of 125 fpm is to be reduced to 68 fpm for smoother operation and to improve operating conditions.

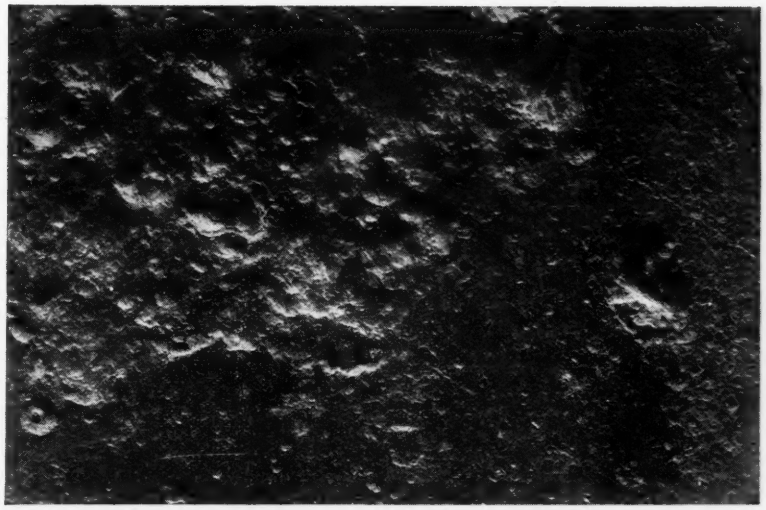
All overhung pinions are to be eliminated.

Keeper plates are to be welded in place in the field against all bearing pads after machinery is perfectly aligned. This precaution will eliminate improper gear meshing in case bearing bolts become loose.

Lock washers are to be installed un-

Fight The Scourge Of Boiler Metal With APEXIOR

APEXIOR provides an impenetrable barrier against corrosion that frequently leads to inefficient operation — costly shutdowns — wasted manpower and horsepower.



Boilers and other equipment exposed to contact with hot water and steam at high temperatures are being effectively protected from premature old age by applications of APEXIOR NUMBER 1. Even some boilers on the inactive list have been returned to service with the help of this thoroughly tested protective coating. In all cases, APEXIOR has extended the period between cleanings and made cleaning much easier and quicker.

APEXIOR—THE PAINT THAT TAKES THE WEAR

APEXIOR NUMBER 1 is a chemically inert "film of safety" for boiler tubes, drums, economizers, and steam turbines. Brush-applied, it fills in the metal pores and joints shutting out water completely. There is less adherent scale, so the problem of scale removal is simplified.

APEXIOR'S tough, smooth surface — not the metal — takes the wear. One application lasts 2 to 3 years or more. It is easily renewed.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many manufacturers of turbines coat shafts, rotor bodies, and frequently interiors of casings with APEXIOR before shipping to customers.

Hundreds of industrial power plants, utilities, railroads, and marine operators have relied on APEXIOR to aid them in fighting the scourge of boiler and turbine metals. It is helping them through this critical period in their history. APEXIOR can do likewise for you . . . prolong the life of your boilers or any equipment having hot wet surfaces . . . conserve manpower and vital materials . . . see you through the war period.

Here are some of the many companies now benefitting by APEXIOR

Hercules Powder Co.
Narragansett Electric Co.
Westinghouse Electric & Mfg. Co.
American Sugar Refining Co.
Tennessee Eastman Corp.
The Pullman Co.
Duke Power Company
Ford Motor Co.
Pittsburgh Plate Glass Co.
Pennsylvania Railroad Co.
General Aniline Works
Standard Oil Co. of Indiana

See how easily APEXIOR can be applied
Write today for Bulletin 1290 (Industrial) or 1305 (Marine) giving complete details on peak protection for peak production.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY**
of America
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

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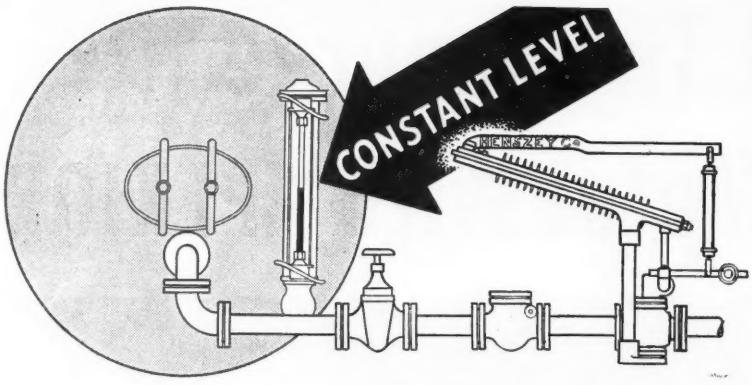


SIMPLE but EFFECTIVE

Boiler Water Level Control

Your boilers, as well as all others, are designed to operate most efficiently when the boiler water is held to the proper level.

HENSZEY

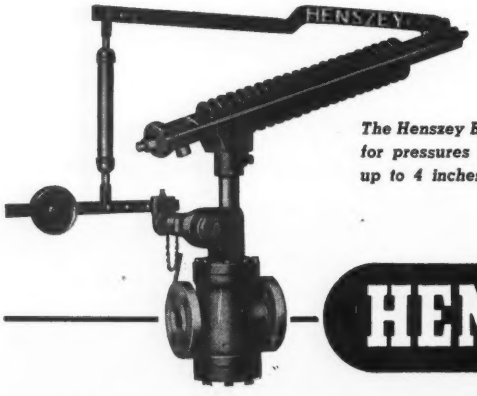
BOILER FEED REGULATORS

will maintain proper boiler water levels continuously, automatically and accurately under all load conditions.

The Henszey Regulator is easily installed right in the feed line — no additional structural supports are needed. When feed water is needed this unit delivers it—in just the right amount to bring the level back to where it belongs.

Now is the time to plan for low cost, accurate boiler level control. Send for bulletin.

HENSZEY CO. Dept. C-10 Watertown, Wis.



The Henszey Boiler Feed Regulator is made for pressures up to 600 lbs. and in sizes up to 4 inches.

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

der all nuts. Crane and carriage wheels are to be double flanged.

Pilot bearings are to be provided for idler gears in the operating head.

All operating head gears are to be heat treated.

Gears, drums, and carriage wheels are to have heavy press fits.

Screw flights to be of high carbon steel to provide longer life against wear.

Maintenance

With the improvements in design and construction as outlined, the extent of maintenance should only be that of proper lubrication and periodical replacement of screws, hoisting rope, and solenoid brake bands.

The removal of screws from the spindles for replacement with new is easily accomplished by removing the combination nut and screw point and sliding the screw assembly off the spindle.

A sufficient amount of hoisting rope and drum capacity is provided to permit lowering of the operating head to a horizontal position at the track level when replacing hoisting rope or in case of repairs on the operating head.

The estimated amount of coal unloaded with the accelerator now in operation is about 700,000 tons. One new set of screws and the third hoisting rope have recently been installed.

Conclusion

In conclusion, it can be stated definitely that with the improvements in design and construction very few operating difficulties will be experienced and that for capacities of 200 to 250 tph for frozen, wet coal which has been thawed by suitable means, and from 250 to 300 tph for wet, fine coal, this equipment will give very satisfactory results. Damage to cars is not serious and is considerably less than that caused by most dumpers.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

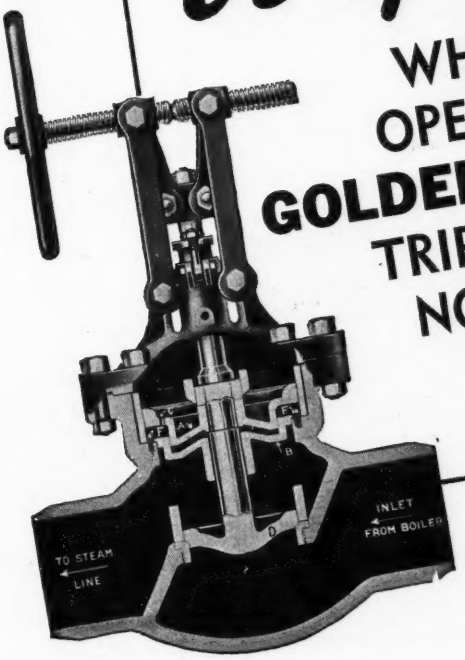
Steam Alkalizer

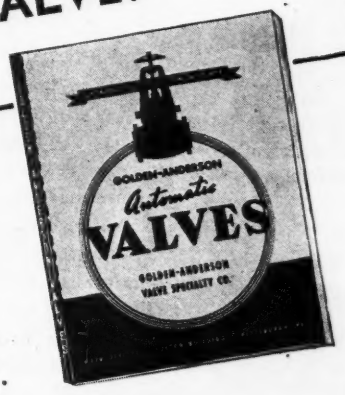
THE SUHM-MAC Steam Way Economizer developed by Suhm Co., Inc., 1942-G South Kinnickinnic Avenue, Milwaukee 4, Wis., is a unit for chemically conditioning steam, consisting of a 10-gal tank with one or more drip valves for connection to steam headers. Each valve is equipped with glass vial and adjustable vernier gage for accurately controlling the alkalizing liquid flow to requirements of the system.

The operation of the new unit is to condition the steam, alkalizing all possible acidity, which, if allowed to continue in the steam line, destroys the metal pipes, traps, pumps, and other parts and causes excessive scale, dirt, and sludge. By alkalizing the free CO_2 gas and oxygen in the steam lines, their destructive action can be prevented, and impurities quickly eliminated from the steam system. This permits oper-

There's no chatter or spinning

WHEN YOU OPERATE THE GOLDEN-ANDERSON TRIPLE ACTING NON-RETURN VALVE!





Here is a valve that operates effectively . . . without banging, chatter or spinning . . . *under any flow conditions!* It's the "Double Corliss" dashpot assembly that does this cushioning job—and makes the GAVSCO Non-Return Valve reliable for any emergency. The design assures perfect alignment of moving parts and prevents galling or binding.

In operation the Non-Return Valve will:

1. **Automatically cut in a boiler whenever its pressure equals line-header pressure.**
2. **Isolate a boiler automatically whenever its pressure, from any cause, is lower than line-header pressure.**
3. **Prevent steam flow from boiler in event of sudden drop of line-header pressure below the boiler pressure by means of differential shot pilot valve.**

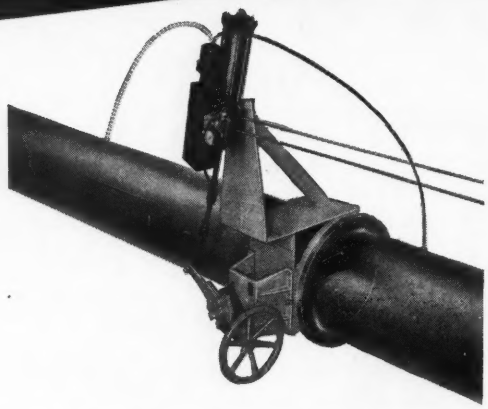
Get this unfailing, automatic life and property protection for *your* operations. The valve illustrated is a Toggle Yoke design, available in sizes from 2½" to 12", to handle 600 to 1500 lb. pressures. Other types we can supply include Angle, Globe, Elbow and Cross patterns.

This catalog contains illustrations and detailed descriptions of all GAVSCO Specialty Valves. Write for your copy today. Get acquainted with this complete line of automatic valves!

GOLDEN-ANDERSON
VALVE SPECIALTY CO.
FULTON BLDG. PITTSBURGH, PENN.

WORLD'S BEST AUTOMATIC Valves

Maintain a Constant UPSTREAM or DOWNSTREAM PRESSURE



No. 501. 125-pound American Standard R-S Butterfly Valve. Declutching unit (patent applied for) permits operation of the valve with either the hand wheel or the positioner cylinder.

15 to 900 psi
for air, gas, steam, liquids and semi-solids

The R-S Butterfly Valve is controlled automatically by the line pressure and is actuated by the oil or hydraulic positioner cylinder attached to the valve. If the line pressure decreases, the valve vane slowly closes until the predetermined line pressure has been reached, at which time the valve vane automatically reopens.

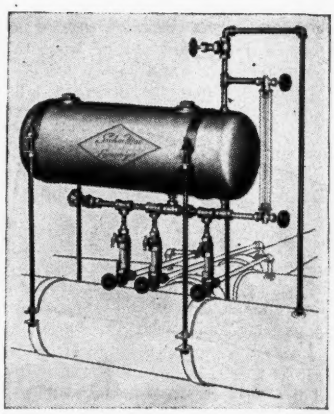
The dotted lines indicate the piping necessary to maintain a constant upstream pressure.

The use of an R-S Butterfly Valve as a main control valve provides unexcelled flow characteristics, simplifies performance, prevents water hammer and reduces maintenance. Operates for pressures between absolute and 900 pounds gauge. State your requirements and ask for Catalog No. 14-B.

No. 529. 30-inch R-S Butterfly Valve with extension shaft for high pressure drops and heavy duty service. Only four to six revolutions of the handwheel are necessary for wedge-type closure.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES



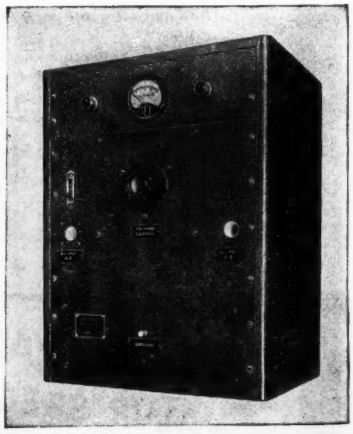
ating the heating system on lower steam pressures, and provides greater efficiency and longer life from pumps, traps, valves, and other operating parts. The result is much lower fuel costs, greater operating economy, reduced maintenance costs, increased radiation, lower labor costs and increased service from the system.

The Suhm-Mac Steam Way Economizer unit is usually attached to the ceiling near the steam headers. Then after a careful test of the condensate, a special liquid formula is provided which flows from the tank through the valves into the steam headers in carefully controlled amounts. A simple testing unit provided for the engineer permits a constant check on the efficiency of the treatment and shows any need for changing the flow from the valves.

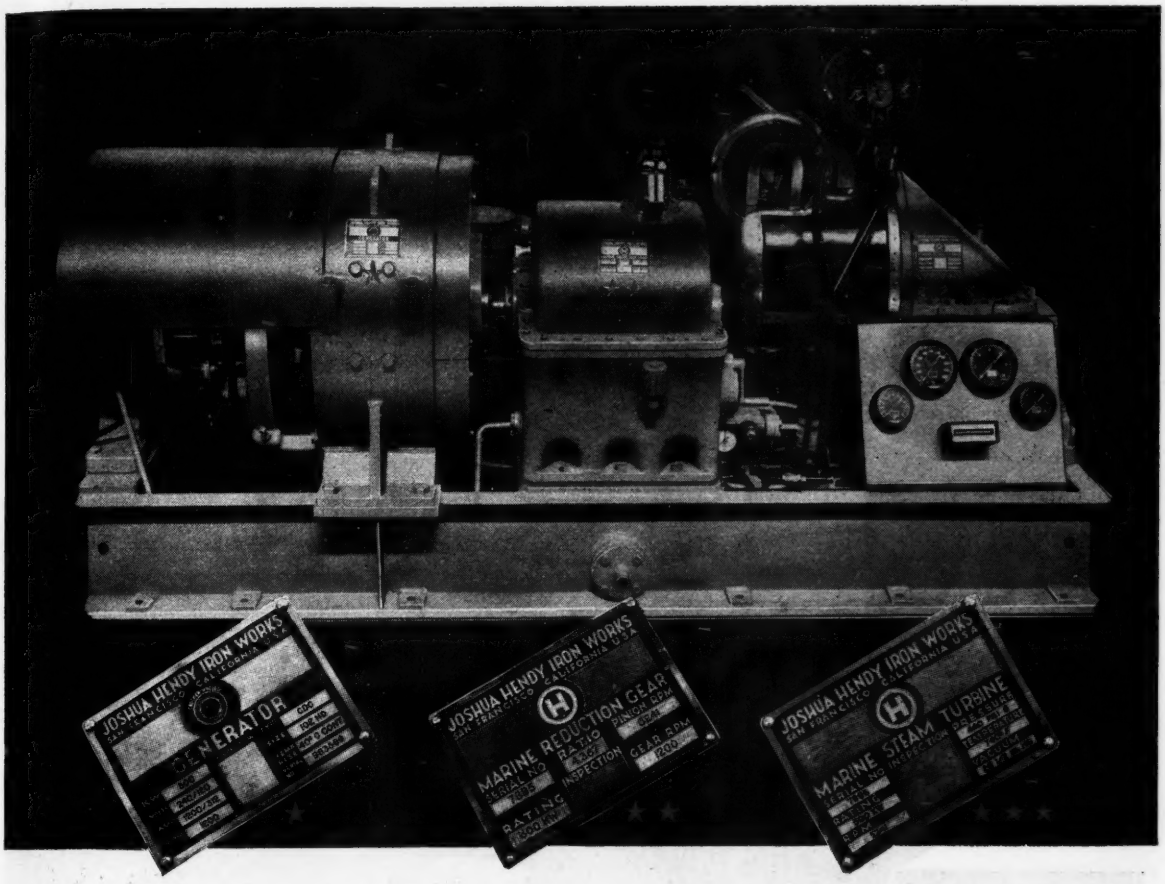
Voltage-Breakdown Tester

MEANS of testing voltage breakdown of materials or components is provided by the Type P-3 Voltage Breakdown Tester recently placed on the market by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City, N. J.

Operating range of instrument is 0 to 10,000 v d-c, or 0 to 8000 v a-c. A lower range instrument, Type P-1, with sloping panel, has a range of 0 to 4000 v d-c, or 0 to 3000 v a-c. The voltage is continuously variable over the entire range.



The voltage-breakdown tester operates directly from 110-130 v 50/60 cycle



A THREE STAR HENDY PRODUCTION

This turbo-generator set was designed as *one complete* power-generation set—not as three separate units. Turbine, reduction gear and generator—all three, Hendy-designed and Hendy-built to give you complete power equipment from one reliable source.

Hendy specifically designed these 250 to 750-kw sets to include many advanced features usually found only in larger turbo-generators. These clean, compact power plants combine strong, modern construction with exceptional simplicity. The usual maze of piping, valves and levers has been eliminated by placing parts in protected locations, leaving neat and trim contours. Appearance is improved—maintenance simplified.

The all-steel turbine allows unusual accessibility and is precision-constructed to assure excellent operating characteristics.

The reduction gear, smooth and clean like the turbine, has its bull gear and pinion mounted in precision-type babbitt-lined bearings to guarantee quiet operation over long periods.

The conservatively rated generator, either a-c or d-c, assures smooth operation because of the unusually close dynamic balance of the armature.

Together, these three matched Hendy-built units form a turbo-generator set completely designed by experienced Hendy engineers, in a range of 250 to 750-kw, to give you the utmost in service for a wide variety of marine or industrial applications.

For complete data write for new catalog on Hendy Type HG-26 Auxiliary Turbo-Generator sets.

JOSHUA HENDY IRON WORKS

ESTABLISHED 1856

SUNNYVALE, CALIFORNIA

Manufacturing Plants: SUNNYVALE, POMONA and TORRANCE in CALIFORNIA • AMPERE, NEW JERSEY • ST. LOUIS, MISSOURI 58-TR-5

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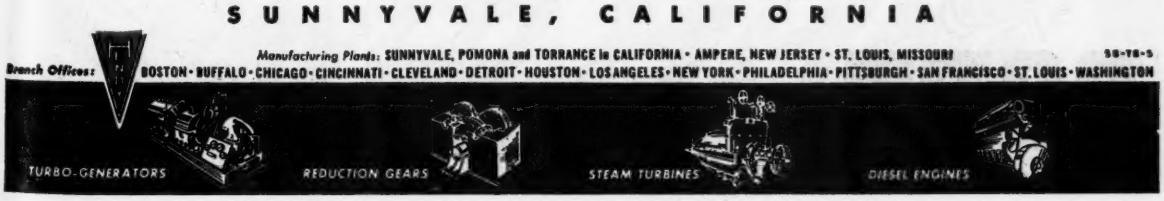


Here's where DARTS are Different

Two Bronze Seats — Ground to a True Ball Joint

Two bronze seats accurately ground to insure true ball joining make Dart the *better* union. It will sit tight indefinitely, yet is ready to be moved instantly whenever you have a new job for it. Body and nut—made of high-test air-refined malleable iron—are practically unbreakable. Darts are purposely built to give longer service . . . thus, in the long run, cost less. Call your supplier.

Good pipes become a good piping system when you use Dart Unions.

DART UNIONS **DART UNIONS LIVE LONGER**

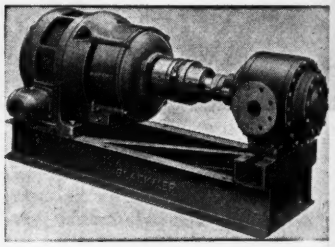
E. M. DART MFG. CO., Providence, R. I.

a-c line. A panel light indicates when instrument is "On". Breakdown is indicated by a red signal light, while the built-in meter indicates the direct-reading voltage. Current-limiting resistors safeguard the equipment in the event of a dead short, by limiting the current to approximately 50 milliamperes. Uniformity over the entire range on this model P-3, or 5 milliamperes on model P-1. To speed up production testing, drawer-switch type fixtures are available. These fixtures have a jig to take given components or materials, and when the drawer is closed the voltage is applied, with absolute safety for the operator. External connections are made by means of an insulated plug inserted in the high-potential a-c or d-c jack, with the other side grounded.

High Pressure Rotary Pump

BLACKMER PUMP Co., Grand Rapids, Mich., has designed and put into production a new pumping unit suitable for discharge pressures of 500 psi.

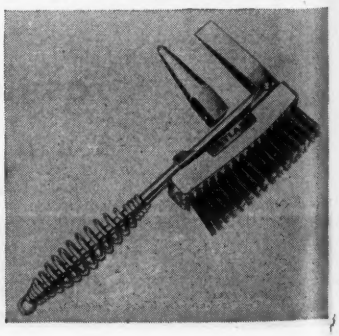
These new pumps are built in all iron and bronze fitted constructions. Rated capacities 50 and 90 gpm for discharge pressures to 500 psi. Standard motors with separate gear reduction or gearhead motors may be used. Units are also available for engine drive. While current production is entirely on the 50 and 90 gpm sizes, it is planned that large capacities will be available later.



Several of the new units have been furnished for pumping oils of various types and they are designed for handling similar liquids having lubricating properties. The new pumps employ the "bucket design" (swinging vane) principle. The casing and working parts are, of course, designed to withstand the high pressure.

Weld Cleaning Tool

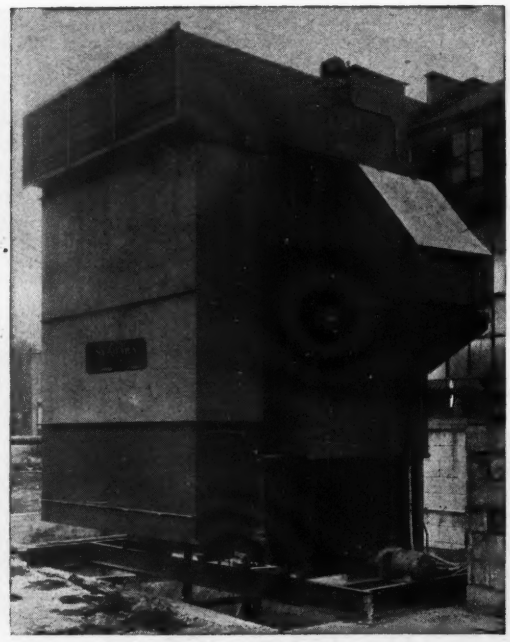
ATLAS Model A Dual-Tool, developed by Atlas Welding Accessories Co., 14824 Wyoming Avenue, Detroit 21, Mich., combining wire bristle brush and slag removing head in one unit, is an improved weld cleaning tool for welders. The tool features an improved



Safety Valve Piping, 42" O. D. Header with 10-12" inlet connections.
NAVCO
Pre-Fabricated
Piping
means
ACCURACY•DEPENDABILITY
Desuperheated Safety Valve Discharge Header 30" O.D. outlet, with 6-12" welded inlet.
Turbine Exhaust Vent Hood. Outlet 20" O. D., with 4-10" inlets.
There are many advantages in shop fabricating such assemblies as shown here. Better control of welding is afforded — Economies are effected — Closer tolerances can be maintained. The extensive facilities of Navco Shops insure reasonable deliveries even in these days of Defense Programs and Priorities.
NAVCO
NATIONAL VALVE & MFG. CO.
Pittsburgh 1 Pennsylvania
NAVCO PIPING

"BALANCED WET BULB" TEMPERATURE CONTROL

U. S. Patent Re-issue No. 22,533



Don't PURCHASE COOLING WATER!

● Whenever a process calls for the use of water to cool liquids or gases, investigate using the NIAGARA Aero HEAT EXCHANGER to gain these benefits:

1. Year 'round operation at full efficiency.
2. Reliable temperature control within 2°F.
3. Elimination of water treatment.
4. Saving 95% of water consumption.
5. Avoiding risk of shutdown in time of water shortage.
6. Saving piping, pumping and power and equipment costs.

The NIAGARA Aero HEAT EXCHANGER, using outdoor air as the cooling medium with the evaporative method, removes 1,000 B. T. U. from a liquid for each pound of water evaporated. Accurate temperature control within 2°F. is assured by the Niagara patented "Balanced Wet Bulb" control which always provides the correct admixture of fresh and recirculated air. Hundreds of industrial plants, operating a wide variety of processes, have found it the most reliable, most compact and economical apparatus for liquid cooling. Write for Bulletin 96.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. PP-104, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

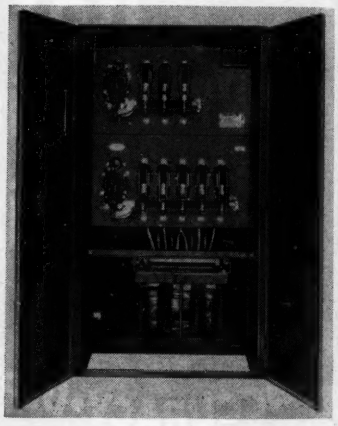
NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

brush holder which permits removal of the brush for reversing or replacement by inserting a screwdriver at rear end of holder. Up and outward pry releases tension and the brush pops out. Reverse action for inserting and brush snaps in to a firm rigid seat. Flex-O type spring steel handgrip permanently welded to handle eliminates the possibility of loosening or breaking. Chipping head is hand-forged tool steel. Every part of this tool is replaceable, including cone and chisel heads.

Magnetic Motor Starter

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., has announced a new magnetic, reduced voltage cage motor starter, which protects motors from sustained overloads, locked rotor condition, single-phasing and overloading from too frequent starting. This is accomplished in the new starter—called type "ARC"—with a calibrated, thermal overload relay. The new starter is now available for control of motors from 5 to 2500 hp, up to 5000 v, 3-phase, 50 or 60 cycles.



Reduced voltage, two-point starting is obtained with a built-in auto-transformer, utilizing accurate, synchronous motor-driven, adjustable timing relay for transition from starting to running position. Interrupting capacity rating of the new starter is ten times the motor's full load current.

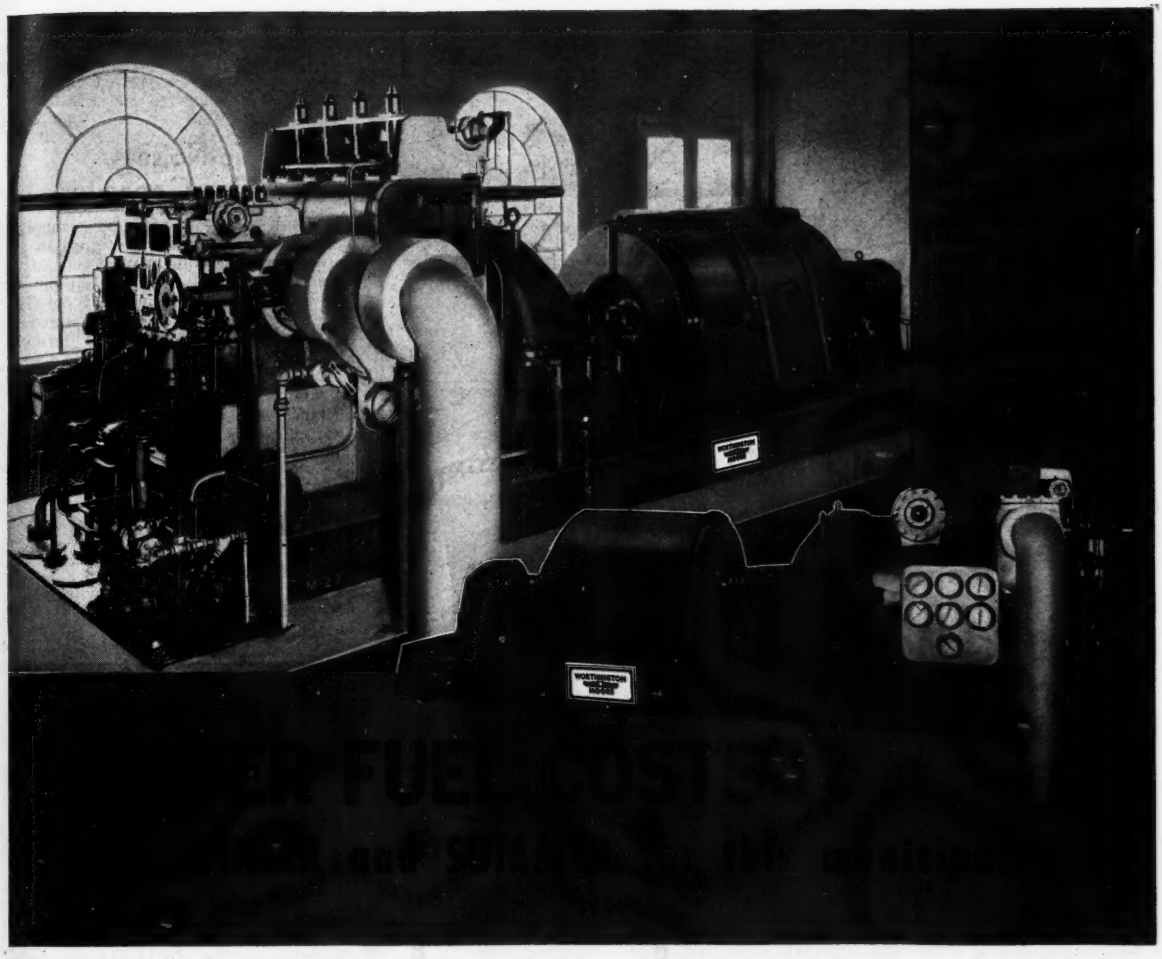
Insulating Materials

THE INSULATION DIVISION of the Eagle-Picher Sales Co. has announced through its vice president and general manager, T. C. Carter, the addition of four new products to its line of insulating materials.

Eagle Swetchek is an insulation for minimizing condensation from such pipes as cold water lines, water coolers and softeners, storage tanks, filters and condensers.

Eagle Drycote is a plastic coating, white in color, and packaged in dry form. When mixed with water and applied by trowel or hand application to any clean dry surface this material becomes smooth and glossy white in color and sets into an extremely hard surface. It is highly fireproof.

Eagle Hadesite is a fireproof insulating cement for high temperature work. This material is mixed with water and trowled to a smooth hard finish being used primarily for fireproofing structural steel, lining high temperature ducts, firedoors, etc., up to 1900 F.



When electrical and heating requirements vary widely at different periods or seasons, there is bound to be an excess of fuel consumed unless there is suitable provision on the installation for balancing the heat and electrical loads. Worthington-Moore Condensing Bleeder Turbine Generator Units are ideal for such conditions.

The two units illustrated above operate with steam at 350 lb. gauge-pressure, 635° F. total temperature, exhaust to 28" vacuum and extract steam at 10 lb. gauge pressure for heating. Both of these units give efficient operation straight condensing during the summer months and provide bled steam for municipal heating purposes during the winter.

Moore Engineers will be glad to study your electrical and heating requirements and give you an estimate of the fuel savings possible with a Worthington-Moore Unit.

BEHIND THE NAME
WORTHINGTON
MOORE

MR4-2

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, NEW JERSEY • MOORE STEAM TURBINE DIVISION, WELLSVILLE, NEW YORK

R/M KEEPS THE STREAM ON THE BEAM

Just as a ringmaster keeps a show on the go, R/M packings keep liquids on the flow. Every R/M packing is engineered to be the best and most lasting product for the job it has to do. When super-heated steam starts bubbling, when pumps begin to lose pressure, when gases leak, or oil drips, there is an R/M packing designed to whip them back into line.

Government demands for R/M packings will gradually be relaxed as the end of the war approaches. Be sure to ask for R/M products whenever they are available.

INDUSTRIAL SALES DIVISION

RAYBESTOS-MANHATTAN, INC.

MANHEIM, PENNSYLVANIA

Bridgeport, Conn ★ North Charleston, S. C. ★ Passaic, N. J.

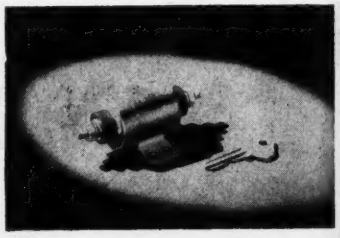
MAKERS OF PACKINGS FOR EVERY INDUSTRIAL USE

Eagle 43 Finishing Cement is used for finishing interior insulation work where an extremely hard, smooth surface is desired. It can be painted and withstands temperatures to 800 F.

G-E Radio-Noise-Suppression Capacitor

A NEW PYRANOL* radio-noise-suppression capacitor, specially designed to reduce radio-noise voltage from generators, inverters, motors, and other equipment, has recently been announced by the General Electric Co. The capacitors are of the thru-stud type with a terminal at each end. One line of a d-c or a-c power circuit can be "fed" through the unit, thereby reducing internal inductance and resistance, and increasing filter efficiency for a given capacitance. The capacitors are especially effective in reducing radio noise at higher frequencies.

They are compact and lightweight. The physical dimensions are approximately 1¾ by 3⅝ in., and the unit weighs only 4½ oz. They can be mounted in any position and will operate over a temperature range of plus 50 C to minus 50 C.



The capacitors are currently available and are rated 0-100 amp, 250 v maximum a-c or d-c, 0.55 microfarad. They are designed to meet exacting vibration tests required by U. S. Army Air Forces Specifications.

Bulletin GEA-4308, containing complete information on the radio-noise-suppression capacitor, is available upon request from General Electric, Schenectady 5, N. Y.

*Reg. U. S. Pat. Off.

OBITUARIES

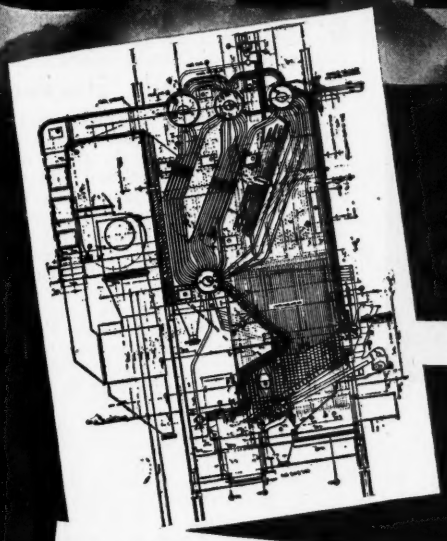
Dwight L. Armstrong

DWIGHT L. ARMSTRONG, Vice President of the Armstrong Cork Co., died in Lancaster on September 10 after an illness of four weeks. Mr. Armstrong was born June 4, 1894 in Pittsburgh, the son of Charles D. Armstrong, former President of the Armstrong Cork Co., and grandson of Thomas M. Armstrong, founder of the company. He was graduated from Yale University with the degree of A. B. in 1917.

In the first World War he enlisted in the Navy and was commissioned as an Ensign. In that capacity he served on the U. S. S. George Washington, the ship which carried President Wilson to the Peace Conference in Paris.

Mr. Armstrong entered the employ of the Armstrong Cork Co. in 1919 in its Pittsburgh factory. In 1930 he was named Vice President in Charge of

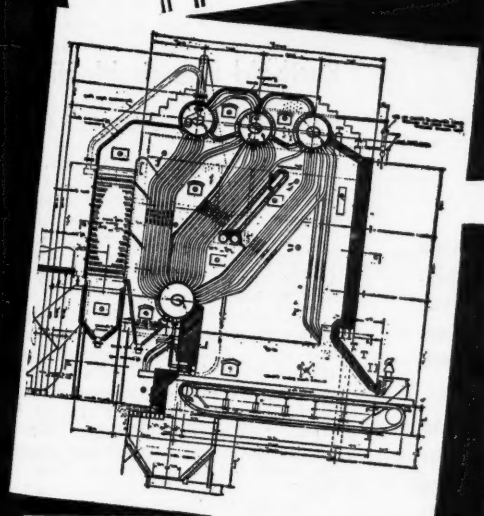
STEAM for



POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

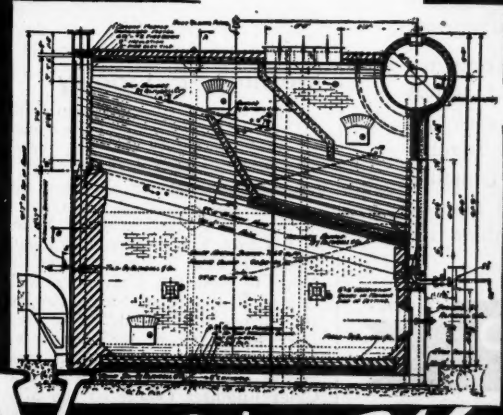
90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.



PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.



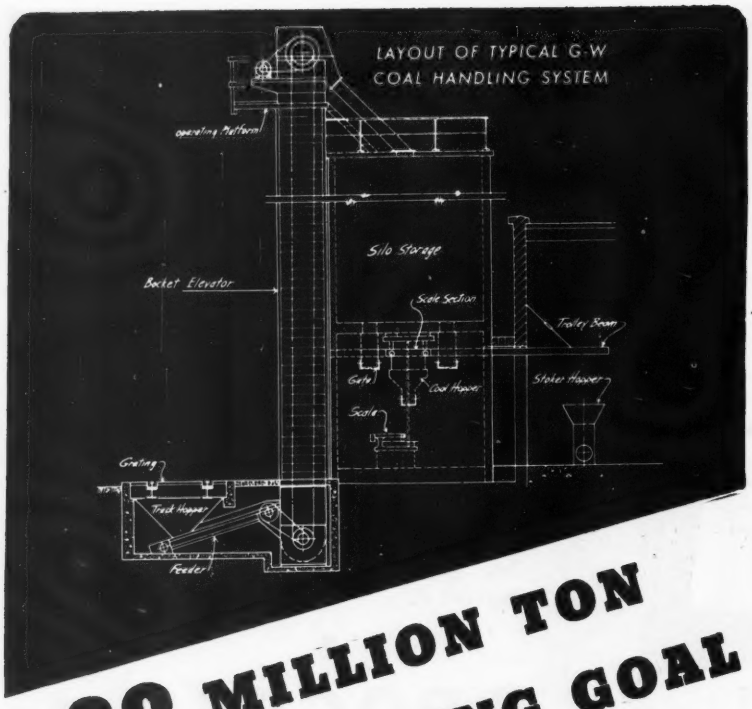
HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND CHICAGO PHILADELPHIA DALLAS

Vogt Water Tube BOILERS
BENT TUBE AND SECTIONAL HEADER TYPES



A 29 MILLION TON COAL-SAVING GOAL

The National Fuel Emergency Council has undertaken a drive *by* industry and *for* industry to help stretch our fuel supply. Their coal-saving goal this year is ***29,000,000 tons.*** Success will avert a disastrous fuel shortage—success will avoid curtailment of war industries and allocation of fuel—success will speed Axis defeat.

G-W believes that every man in industry will lend his fullest cooperation in furthering the National Fuel Efficiency Program, by checking every possibility in his own plant for furthering economies in power generation—right on down to the receiving of coal and its delivery to boilers or pulverizers.

As designers and builders of coal storage and coal and ash handling systems for over 130 years, Gifford-Wood stands ready to cooperate with you to the fullest. Standard and special designs—or combinations—to meet individual requirements will gladly be adapted by G-W engineers in consultation with your Engineering Dept. Catalog E-200 will also be a big help with its 120 pages of pictures, drawings, tables and Engineering data. Write for your copy today.

6236

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FOUNDED 1814

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Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries

Sales, which position he held until 1933 when he was made Vice President and General Manager of the Closure Division. On April 15, 1939 his responsibilities were broadened and he was attached to the President's Office as a general executive vice president. He had been a member of the company's Board of Directors since 1931.

Rupert Kennedy Stockwell

RUPERT KENNEDY STOCKWELL died on August 24 at his home in Oakland, Calif., his death being the result of a heart attack. Mr. Stockwell was born in Birdsall, N. Y. on January 25, 1882. He joined Robins Conveyors, Inc., as a draftsman in 1911 and a year later became Chief Engineer for a project of the Braden Copper Co., at Rancagua, Chile, and spent the next five years at this location. He became Sales Manager of the company in New York in 1917 but went abroad in 1919 to open the Robins office in London, where he had charge of Engineering and Sales for the company.

From 1933 to 1937, Mr. Stockwell was in charge of sales for Robins in Shanghai, China. His territory included China, Japan, Korea, Manchuria, Hong Kong, Malay States and Borneo. He opened an office in San Francisco in 1938 where he was in charge of all Robins sales on the Pacific Coast.

Berthold Francis Hastings

BERTHOLD FRANCIS HASTINGS, District Engineer of the American Institute of Steel Construction, died on Friday August 11 at Philadelphia. Mr. Hastings was stationed in Philadelphia where he represented the Institute from 1928 to date. He was a graduate of Yale Sheffield, Mining Engineer in 1910 with a degree of Ph. B., and in 1912 the degree of E. M. was conferred upon him by Yale Mines.

Following graduation he was engaged in the design and construction of irrigation and hydro-electric projects; having been associated with Highway Bridges in Iowa; Railroad Bridges for New York, New Haven and Hartford Railroad; and Mill Buildings. He also did designing and construction engineering work for H. G. Balcom, New York City.

He was Professor of Structural Engineering, School of Architecture, Carnegie Institute of Technology and also conducted a consulting engineering practice.

Mortimer E. Cooley

MORTIMER E. COOLEY, Dean Emeritus, College of Engineering of the University of Michigan, died in Ann Arbor on August 25 at the age of 89 years, after being hospitalized for almost a year.

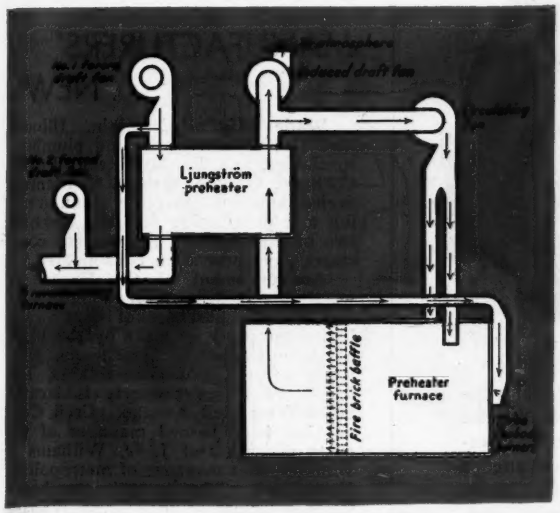
Mr. Cooley entered Annapolis from his home in Canandaigua, N. Y. in 1874 as a Cadet Engineer, and graduated in 1878. In 1881 he was detailed by the Navy to join the University with the title of Professor of Steam Engineering and Iron Shipbuilding. He resigned from the Navy in 1885 but served as Chief Engineer of the U. S. S. Yosemite during the Spanish-American War, as Chief Engineer Officer of the Michigan State Naval Brigade and as Educational Director of the 72 colleges and universities in the middle west comprising the Seventh District of the Student Army Training Corps during World War I.

In 1934 he headed the State Highway Advisory Board and next year acted

COPPER SMELTING AT CHINO
STEPPED UP BY PREHEAT ENGINEERING

Another NEW APPLICATION FOR LJUNGSTROM AIR PREHEATER

The following excerpts from an article appearing in *Engineering and Mining Journal*, July, 1944, tells our story better than we can.



"Use of preheated air in the reverberatory furnace of a copper smelter burning natural gas or oil as fuel is distinctly a new development, despite the fact it has already found wide application in power generation in steel, cement, lime and numerous industrial plants. The air preheater recently installed at Kennecott's Chino smelter, Hurley, N. M. is perhaps the first of its kind on the American continent . . . The furnace is 32 x 126 feet.

"The results are demonstrating clearly the advantages which may be derived from preheated air. Chief among these advantages is that of improved combustion, resulting in higher over-all efficiency.

"The layout of the air preheater service the reverberatory furnace is shown in the drawing. As will be noted, it consists of a separately fired preheater furnace, and the preheater proper, with fans and control equipment. *The preheater is a Ljungstrom* 19½-V-72 unit, employing the continuous regenerative principle. Its rated capacity is 53,000 C.F.M., the air being received at 60 deg. F, 24.45 in. of mercury, and heated to 926 deg. F.

"In the Chino reverberatory furnace operations, improved combustion has resulted in higher temperatures in the interior of the furnace, consequently bringing about more rapid smelting of the furnace charge."

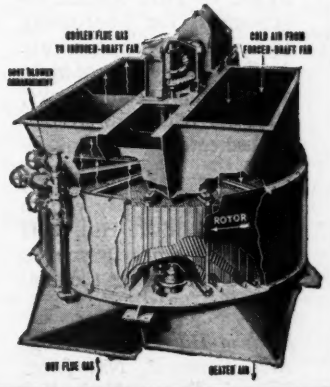
ENGINEERING SERVICE

The engineering staff of the Air Preheater Corporation is prepared to assist you in applying standard or special types of Ljungstrom Preheaters to your fuel conservation needs, or to help you and your engineers make better use of low-grade, more abundant fuels.

THE LJUNGSTROM AIR PREHEATER

The heating surface is contained in a compact, slowly rotating cylinder. Soaking up heat from the hot flue gases, it then rotates to a chamber where it liberates the heat into incoming combustion air.

This continuous, regenerative, counterflow principle assures maximum heat transfer with minimum weight and size. Generally, the Ljungstrom weighs less than half as much as tubular or plate preheaters of similar capacity. With the Ljungstrom, it is possible to obtain preheated air up to 1500 deg. F.



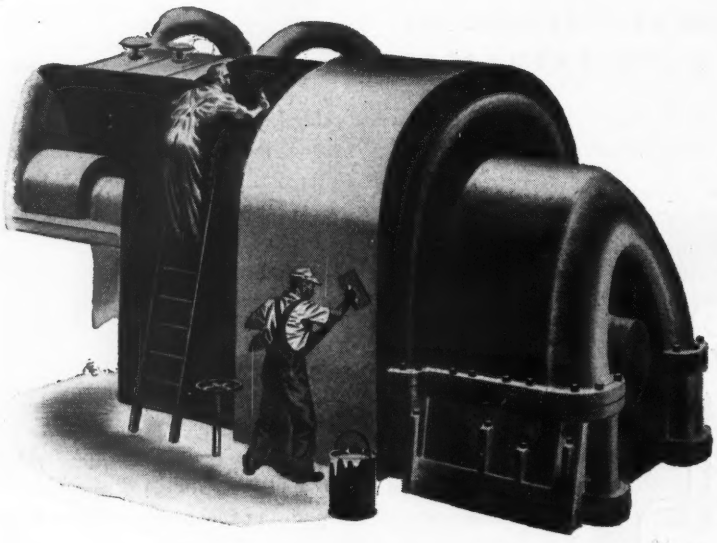
THE
AIR PREHEATER
CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

Greater Fuel Economy with

B-H BLACK ROCKWOOL

INDUSTRIAL INSULATIONS



For long, trouble-free service, and exceptionally low thermal conductivity, you can't beat B-H *black* rockwool. It is physically and chemically stable, which means it will stand up under extreme service conditions. It is moisture-resistant and that means a permanence of physical properties and retention of high insulating value under humid conditions that many other insulations cannot withstand.

B-H insulating products made from black rockwool are designed to meet specific requirements for labor-saving and efficient application. Available in the form of high- or low-temperature blocks, blankets, felts, and insulating cements.

Whatever your insulating problem, it will pay you to consult Baldwin-Hill. B-H insulations can help you do a better job—more economically.

Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, N. J., Kalamazoo, Mich., and Huntington, Ind.

A Product for Every Service

MONO-BLOCK—
effective up to 1700°F

BLANKETS—
effective up to 1200°F

PIPE COVERING—
effective up to 1200°F

INSULATING CEMENT—
effective up to 1800°F

FELTS—
from sub-zero to 800°F

KOLDBOARD—
effective from—150° to 300°F

SOUNDLINER • FILL • WEATHERSEAL • BOND-TITE • ASBESTOS CEMENT DIATOMACEOUS EARTH PRODUCTS

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

as state director of the Federal Public Works Administration. Again in 1938 he was vice chairman of the Mackinac Straits Bridge Commission.

Mr. Cooley became Dean of the College of Engineering of the University of Michigan in 1903 and served as such until his retirement in 1928.

Dean Cooley was highly honored for his pioneer work in the appraisal of public utilities, and was always active in professional organizations, having served as president of the American Engineering Council, the American Society of Mechanical Engineers, the Society for the Promotion of Engineering Education and the Michigan Engineering Society, and as Vice President of the American Society of Civil Engineers. He held membership in many other organizations, and was honored with such awards as the Navy Service Medal, the Sampson Medal and the Washington Award for distinguished service to the profession.

MANUFACTURERS' NEWS

Wade Mfg. Co., Elgin, Illinois, makers of Wade drains and plumbing specialties, and Portland Iron Works, Portland, Oregon, makers of Fleming drains, announce that the manufacturing and distribution facilities of these two organizations in the western coast states have now been consolidated.

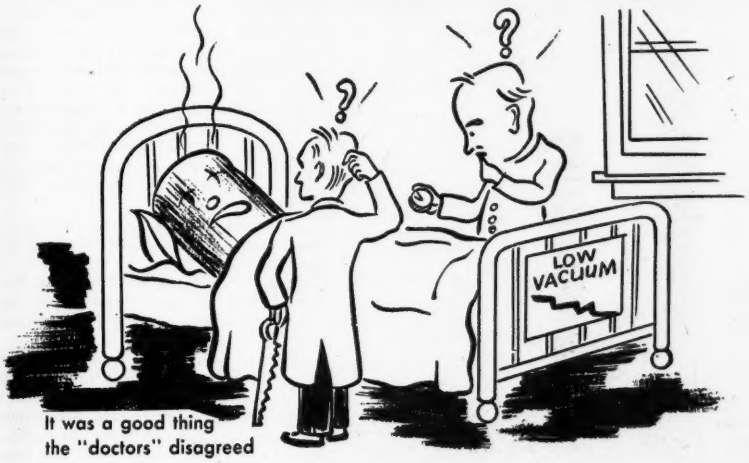
Announcement of the leasing of warehouse facilities in New York City and outright purchase of its Chicago branch property, is made by the U. S. Machine Corporation, Lebanon, Ind., manufacturers of Winkler stokers. The four-story leased property is located at 70 West End Avenue. Cecil Connor has been named manager of the parts division and J. O. Williams is Winkler sales manager of metropolitan New York. The recently purchased Chicago branch at 1614 South Wabash Avenue is managed by Cecil V. Matthews and was established by the company in 1941. A. H. Porche is Chicago district sales manager. The three Lebanon Winkler plants have been expanded to 250,000 sq ft, making possible a mass production capacity of thousands of bituminous and anthracite stokers a month.

American Engineering Co., Philadelphia, Pa., in a meeting of the Board of Directors held on July 31, elected T. E. McBride to the office of vice president and treasurer of the company. Mr. McBride previously held the office of treasurer and was formerly comptroller of Republic Drill and Tool Co., of Chicago, and supervising senior accountant of Arthur Andersen & Co. Until recently Mr. McBride made his home in Chicago.

The manufacturing and sales rights of all interests in stokers manufactured by the Whiting Stoker Co. of Chicago have been acquired by the Lidgerwood Mfg. Co. of Elizabeth, N. J. The purchaser is the manufacturer of heavy construction and marine auxiliary machinery and tunneling and mining equipment.

General Electric Co. has announced the retirement of Christian Steenstrup as Chief Engineer in charge of GE's Refrigeration Engineering division. D. F. Newman was appointed engineer, succeeding Mr. Steenstrup, and L. W.

Ailing Vacuum Cured by REMOVING 20% of the Condenser Tubes



It was a good thing the "doctors" disagreed

THE operators of a large dredge were troubled by low vacuum. The consensus of opinion was that a larger condenser was required, and the operators were reconciled to this eventual necessity. Our engineer, who was called in to quote on some retubing work, suggested that a modification of the existing condenser would increase the vacuum.

We got the job. After removing over 20% of the tubes and making a minor change, the desired vacuum was obtained, and the dredge has been fit as a fiddle ever since.

Why not have a Conseco overhaul to guard against untimely condenser trouble—while the unit is down for a general checkup? Condenser Service has the men, the know-how, and facilities to recondition your condenser quickly and thoroughly. We work every day in the year, around the clock. Don't hesitate to call us any hour, day or night.

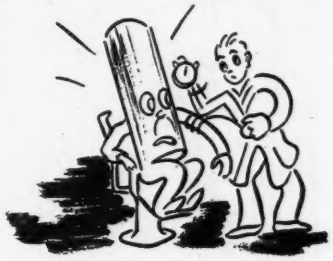
Condenser DO'S and DON'TS

Stop Air Erosion—

Air in circulating water destroys tube ends and tube sheets. A Conseco Air and Erosion Eliminator, with removable screen plates and air ejection piping, will stop this trouble forever. Tube and tube sheet life increased at least three times.

Eliminate Weak Tubes—

Frequently, less than 10% of tubes in large condensers require replacement, but, unless discovered and removed, they will soon necessitate another shutdown and even major overhaul. Even a complete retube job doesn't assure you against trouble, because one of the new tubes may prove defective. For 10 years, the Conseco Hydro-dynamic Shock Tester has eliminated all guesswork about tubes by destroying those ready to fail anyway. If a tube passes our test, it must be good.



Stop Tube End Erosion—

Use FLOWRITES, replaceable, inexpensive belled-end inserts for entrance ends of new or old tubes. They provide smooth, directed flow of circulating water, and prevent air-induced erosion of tube ends. Venturi effect reduces friction from 10 to 84%.

Stop Tube Leaks—

Fast—Conseco Wizard Injector and Sealing Compound stops leaks almost instantly. Inexpensive. Easily installed.

Don't Scrap Tubes with Worn Ends—

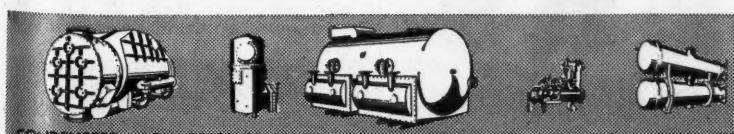
If they pass our shock test, we can stretch them to usable length, cut off the worn ends and return them to useful service.

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

SERVICE

CONDENSER SERVICE & ENGINEERING CO., INC.

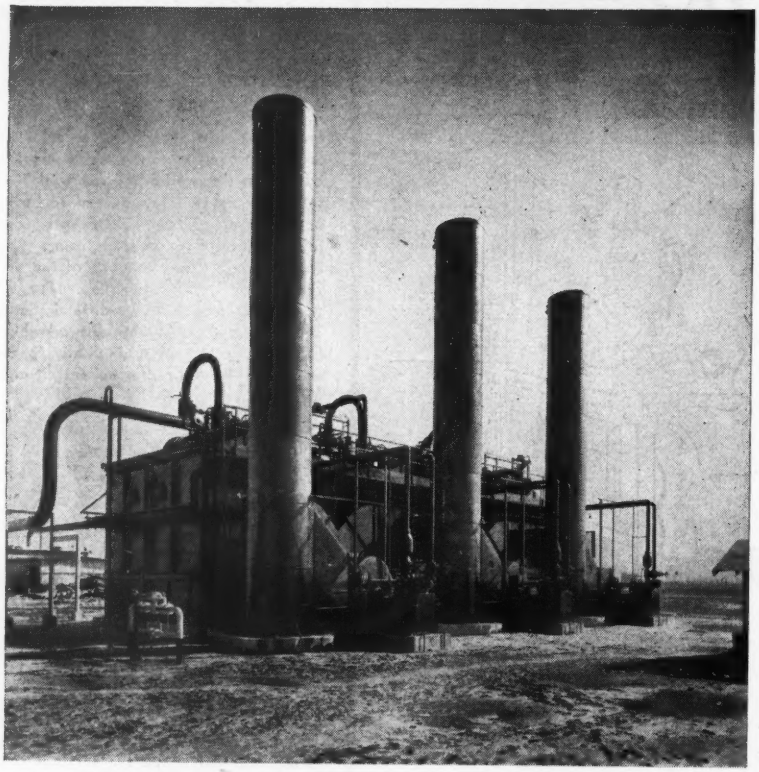
83 RIVER STREET, HOBOKEN, N. J. **Phone HOboken 3-4425** **After 6 P.M. or Sundays HOboken 3-4428**



CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

UNION



DISTILLATE PRODUCTION CORPORATION—NORTH HOUSTON, TEXAS

3 UNION—"H"—Type Steam Generators With Self Contained Water Cooled Furnaces and Steel Cased Settings.

Selected by The Hudson Engineering Corporation for Continuous Dependable Service.

UNION IRON WORKS ★ ERIE, PA ★

BOILERS

PRESSURE VESSELS • PLATE FABRICATION

Atchison made assistant engineer. Mr. Steenstrup developed the hermetically sealed refrigerator unit, and after 43 yr of distinguished and efficient service requested to be relieved of his responsibility as head of the division.

Latin American industrialists are to be offered an opportunity to provide groups of employees of their own choosing with free technical and practical instruction in precision industrial instrumentation in this country, it was announced by E. B. Evleth, vice president and general manager of Brown Instrument Co., precision industrial instrument division of Minneapolis-Honeywell Regulator Co. Instruction will be conducted at the Brown School of Instrumentation in Philadelphia.

Announcement that General Electric had purchased a 155-acre plot of ground, in Liverpool, five miles from the city of Syracuse, N. Y., and planned, when necessary materials are released by the government to build a new plant and make it the headquarters for the company's Electronics department, was made by Gerard Swope, president, at a Chamber of Commerce dinner in Syracuse, Thursday night, August 24.

Although definite plans for the proposed plant have not been made, preliminary arrangements call for the erection of several buildings so landscaped that it has already been suggested the plant be called "Electronics Park."

The announcement was made before 250 of Syracuse's leading business men. Dr. W. R. G. Baker, vice president in charge of the Electronics department, followed Mr. Swope with an explanation of electronics and what the future might be in this new development. "We do not know, of course, how much electronic business will amount to in the United States." Dr. Baker said, "However, one measurement is that the total potential based on present knowledge this year will be approximately four billion dollars. Of course, this can not be obtained after the war but it is possible that at least there will be two billion during peacetime."

MANUFACTURERS' PERSONALS

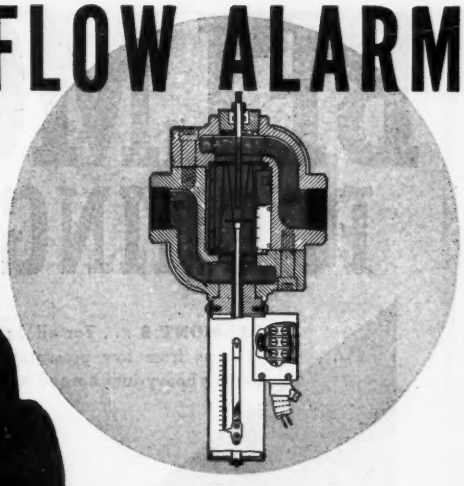
Maxon Construction Co., Inc., of Dayton, Ohio, announces that Frank E. Bell, former construction engineer and acting project manager for the TVA Watts Bar project, has become associated with this organization and brings to the company a wide and varied experience in hydro, steam and electrical engineering, and construction projects.

Ralph W. Hisey, vice president of The Osborn Mfg. Co., has been appointed to the position of vice president in charge of all manufacturing and engineering of both the brush and machine divisions of the company. He has been associated with Osborn for the past 30 years. The company also announces that Hugh M. Little has been appointed works manager of both divisions.

The appointment of C. C. Franck as manager of land turbine engineering in the Steam Division of the Westinghouse Electric and Mfg. Co. has been announced. L. C. Fletcher was made

A NEW, POSITIVE FLOW ALARM

—actuated by flow rate changes *only!*



ROTA-SIGHT FLOW ALARM

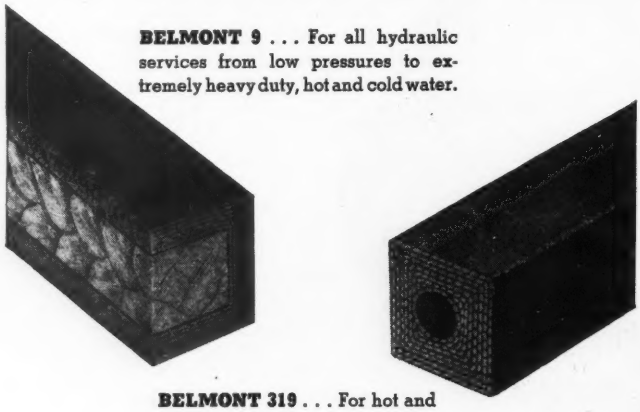
When the flow rate becomes dangerously high or low the Rota-Sight Alarm will flash a red light, start or halt electrical equipment, kick solenoid valves to a new position, or set off a raucous warning horn. Furthermore it definitely indicates the actual flow rate at all times.

The Rota-Sight Alarm operates through a float which moves up and down in a precision-bore transparent metering tube, into which triangular flutes have been fashioned. As the float rises, the flow passage through these flutes increases, causing the float to assume a position in the tube in direct proportion to the amount of liquid or gas passing through the meter. Thus the float responds to flow rate changes *only*. A magnetic extension attached to the float trips an external switch to operate the alarm circuit through a suitable relay. The switch operates *accurately* and *positively* at the flow rate for which it is set, and is readily adjustable over the entire flow range of the Rota-Sight.

This remarkable flow rate alarm is compact, inexpensive and easy to install. It is available in sizes from ¼" and up, in any metal that can be cast. It may be obtained with single alarm, or with double alarm for high and low flow protection. For inflammable or explosive fluids, the alarm fixture may be made explosion-proof. Furthermore, without the alarm attachment, the Rota-Sight is a small, low-priced flow rate meter that will indicate the true flow rate continuously. Bulletin 92-B, containing a detailed description, will be sent gladly at your request upon your Company letterhead. Write to Fischer & Porter Co., 5910 County Line Road, Hatboro, Pa.

FISCHER & PORTER COMPANY

BELMONT PACKINGS



BELMONT 9 . . . For all hydraulic services from low pressures to extremely heavy duty, hot and cold water.

BELMONT 319 . . . For hot and cold water rods and plungers.

FOR WATER

Belmont 319 Hollow Center Packing and Belmont 9 Special Hydraulic Packing will properly seal stuffing boxes of heavy hydraulic units such as presses, accumulators, draw-benches, squeezers and pressure pumps.

The hollow center of Belmont 319 Packing, provides a point of least resistance for expansion and extraction. Hence, the packing will "breathe" toward the "hole" as varying conditions of service within the stuffing box are exerted upon it.

Belmont 9 combines two distinctive materials made into one integral packing. The channel not only acts as a wiper, but as a protection to the inner body of flax . . . these two packings used in alternate rings make an ideal combination set.

Authorized Belmont distributors are located in every large industrial center to make recommendations on your requirements, or if you desire, a request on your company letterhead will bring a copy of the Belmont Catalog displaying the complete Belmont Packing Line in detail.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

steam application engineer in the marine section, S. W. Schmidt supervisor of subcontracting and J. R. Thomas superintendent of fabricating and welding.

Frank C. Angle, manager of Allis-Chalmers sales activities in the Pacific Region, has just been appointed manager of all Allis-Chalmers Field Sales Offices of the General Machinery Division and their operations. He will continue to supervise operations of the Pacific Region.

H. W. Christoffers, L. T. Dupree and **R. B. Schneider** have recently joined the staff of Arthur D. Little, Inc., Cambridge, Mass., industrial research organization. Mr. Christoffers was previously with Commercial Filters Corp., Mr. Dupree with Servel, Inc. and Mr. Schneider with the central development group of Allied Chemical & Dye Corp.

Russell H. Foss was recently appointed district sales manager for the New York District of Hazard Wire Rope Division of American Chain & Cable Company, Inc. Mr. Foss, who has been with the company for 6 years, will continue to make his headquarters at 230 Park Avenue, New York.

J. M. Cook has been appointed manager of the San Francisco District Sales Office of Cutler-Hammer, Inc., whose home office is in Milwaukee, Wis. Since 1933 Mr. Cook has been located in the Cincinnati District where he was handling the sale of all Cutler-Hammer products for all classes of industry. The San Francisco District Office has charge of the sale of all Cutler-Hammer apparatus in that territory.

Alexis J. Diakoff has been appointed Consulting Engineer of the Diesel Engine Department of the Schenectady Plant of American Locomotive Co. Mr. Diakoff, who is directly from the University of North Dakota was head of the Mechanical Engineering Department. Prior to his association with the University of North Dakota, he had years of experience as engineer in the European field, having graduated from Moscow Institute of Technology and later received a Bachelor of Science degree from the University of Michigan.

Leon H. Marsh has been elected vice president and sales manager of The Kennedy Valve Mfg. Co. of Elmira, N. Y. Mr. Marsh has been associated with the company for more than 25 years. He will now be in charge of all sales and public relations of the company.

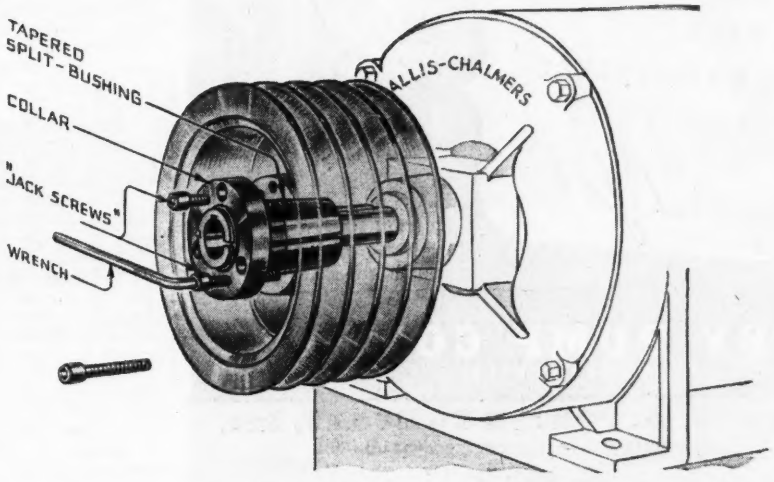
Edgar C. Brandt has been appointed assistant to the general manager of the Crocker-Wheeler Electric Mfg. Co., Division of Joshua Hendy Iron Works. Mr. Brandt has formerly been associated with the Elliott Co. and Westinghouse Electric & Mfg. Co.

R. E. Bressler, formerly Vice President and Chief Engineer has been elected President and Treasurer of the Kol-Master Corp. of Oregon, Ill. He succeeds the late Joseph F. Reed who died last June. Henry G. Wickham was elected Vice President and Joseph C. Reed, Secretary.

G. A. Wieber, formerly resident manager of the Utica District for the Central New York Power Corp. has joined General Electric's Central Station Divisions and will devote his efforts to the company's forthcoming "More Power to America" program,

X-Ray View

OF ALLIS-CHALMERS' NEW "MAGIC-GRIP" SHEAVE



Fastest mounting and demounting sheave on the market, the new "Magic-Grip" costs you nothing extra.

1 **Remove three capscrews** from bushing collar. A handy wrench —supplied with each sheave—is the only tool needed to remove Allis-Chalmers' new "Magic-Grip" from motor or machine shaft quickly and easily.

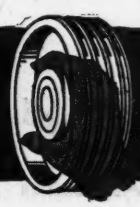
2 **Insert two capscrews** in tapped holes. As screws are turned, they become levers . . . automatically breaking tight grip of tapered split bushing on sheave and shaft. Entire unit is then ready for removal.

3 **Remove sheave from shaft.** Requires no mallet, no prying, no bulging muscles. You just slide the sheave off . . . smoothly, quickly. *It costs nothing extra!* Send for B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1770

Allis-Chalmers Texrope

"MAGIC-GRIP"



SHEAVES

QUIMBY PUMPS

SCREW
ROTEX
CENTRIFUGAL
CHEMICAL

√ LESS FRICTION
√ LESS WEAR
√ LESS MAINTENANCE
IT ALL ADDS UP TO . . .
Longer Life!

PORTER Better Built Equipment Established 1866

QUIMBY VERTICAL SCREW PUMP

QUIMBY PUMP COMPANY
INCORPORATED
Division of H. K. PORTER COMPANY, Inc.
PITTSBURGH, PENNSYLVANIA
FACTORIES:
PITTSBURGH, PA. NEWARK, N.J.

Specify
ECLIPSE
Seamless
WELDED
STEEL
HOSE
FOR

High Temperature Exhausts
ALSO
Seamless Parallel Corrugated

Because Eclipse Metal Hose is manufactured from seamless drawn tubing it is widely used for low-cost handling of oils, chemicals, refrigerants, and other non-solids, non-abrasives. Write us about your problems on conveying these fluids. Ask for bulletin with data on Eclipse Hose sizes and types.

Eclipse Seamless Welded Steel Hose has the flexibility needed to compensate for vibration or movement due to temperature changes. It cannot leak and will not burn out.

THE INVISIBLE CREW
Bendix
AVIATION CORPORATION
Dept. 19-Phila. Div.-Philadelphia, Pa.

also for
GASES · OIL · AIR
HYDRAULIC · VACUUM
REFRIGERANTS
CHEMICALS
ETC.

which is a comprehensive, practical plan, nationwide in scope, developed by GE to assist the electric light and power industry in rebuilding the power load in the immediate postwar era.

Ches Herndon has been appointed manager of Tube Turns, Inc., Houston branch office located in the Commercial Building. Mr. Herndon has been associated with a number of firms in the Southwest where he has been located since 1926.

Littleton C. Barkley, manager of the New York Office of The Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc., has been appointed sales manager of the Manhattan Mechanical Rubber Goods Sales Department. For the present his office will be located at 120 Broadway, New York City.

Owen D. Young and **Gerard Swope** resigned September 8 as chairman of the board and president respectively of the General Electric Co., and Charles E. Wilson was re-elected president by the board of directors. No announcement of a successor to Mr. Young as chairman was made.

Struthers Wells Corp., Titusville, Pa. has announced the appointment of John R. Collette as manager of the new Heating Boiler Division, to be operated as a part of the Titusville Boiler Division of Struthers Wells. Mr. Collette was for 23 years vice president of the Pacific Steel Boiler Division of the U. S. Radiator Corp. in Detroit, Mich.

James L. Dunn, assistant plant manager of the Bridgeport plant of Jenkins Bros., was elected by the board of directors on September 14 to the post of Vice President in charge of Industrial Relations. Mr. Dunn has been associated with Jenkins Bros. since 1913. Among Mr. Dunn's duties in his new capacity will be to participate in all collective bargaining activities; to act as liaison between management and labor; to formulate policies in collaboration with the company's industrial relations committee, and see that such policies as are adopted are carried through; and to act as chairman, and guide the activities of the labor-management committee.

Gordon Lefebvre, president of the Cooper-Bessemer Corp. has been elected to the executive committee of the Machinery & Allied Products Institute. The executive committee on which Mr. Lefebvre serves is made up of executives from the country's leading machinery builders.

Economy Pumps, Inc., Hamilton, Ohio, announces the election of E. E. Quimby and Frank H. Gaylord to positions of Commercial Vice Presidents of that organization. Mr. Quimby will specialize in sales transactions for the very large projects which are too involved for a resale agency, such as flood control, etc. Mr. Gaylord will direct the sales and promotion of Economy's new Wholesalers' Division.

Detroit Stoker Co. has announced the appointment of Elmer A. Kaiser as District Manager of its Cincinnati Office, address 410 Traction Building, 432 Walnut Street, Cincinnati 2, Ohio.

Lucien W. Moore, previously general purchasing agent of Crane Co. has been appointed Manager of the Valve and Fitting Sales Department, with headquarters at the Crane general offices in Chicago. Mr. Moore is succeeded as purchasing agent by Thomas J. Hanlon.

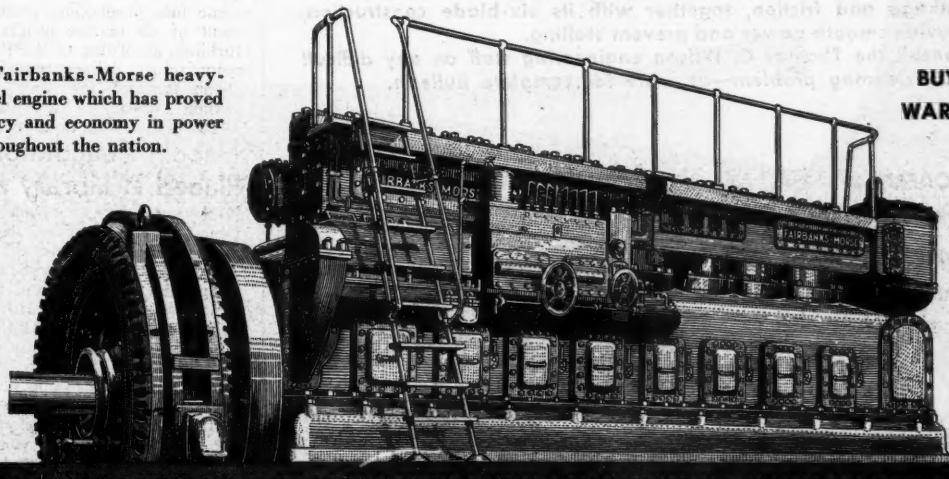
A name worth remembering!

F M

FAIRBANKS-MORSE

After the war, the name Fairbanks-Morse will continue to mark performance-proved products only, as it has for 114 years. No race to get civilian products onto the market early will tempt us to break this pledge.

Below—**Fairbanks-Morse heavy-duty Diesel engine which has proved its efficiency and economy in power plants throughout the nation.**



BUY MORE WAR BONDS

DIESEL LOCOMOTIVES • DIESEL ENGINES • GENERATORS • MOTORS • SCALES • PUMPS • STOKERS • RAILROAD AND FARM EQUIPMENT

FAIRBANKS, MORSE & CO., CHICAGO 5, ILLINOIS

Republic Flow Meters Co., Chicago, Ill., announces the appointment of Merrill Berkley as its exclusive representative in Southern California and portions of Nevada and Arizona, with offices at 742 So. Hill St., Los Angeles, Cal. Mr. Berkley, who was graduated from the California Institute of Technology at Pasadena, with a degree in Mechanical Engineering, has transferred from Republic's Chicago headquarters and will handle sales and application engineering and equipment service for Republic and allied manufacturers. Mr. Berkley has held positions as heating and gas sales engineer with Autogas Corp., Republic Heaters Co., Missouri Natural Gas Co., and the former Los Angeles Gas & Electric Co.

NEWS FROM THE FIELD

Fifth Annual Water Conference To Be Held October 30-31

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA will hold its Fifth Annual Water Conference on October 30 and 31 in Hotel William Penn in Pittsburgh. H. M. Olson, general chairman, has arranged for the presentation of the following papers: Two Zone Methods for Operating Hydrogen Exchangers for Boiler Feedwater Operation, by M. J. Shoemaker, Research Products Corp.; Recent Experiences in Demineralizing Water, by M. E. Gilwood and V. J. Calise, both with The Permuitit Co.; Removal of Ammonia by Chlorination, by A. E. Griffin, Wallace and Tiernan Co.; Once Through and Recirculating Cooling Water Studies, by H. L. Kahler, W. H. and L. D. Betz; Cathodic Protection of Steel Equipment Submerged in Water, by L. P. Sudrabin, Consulting Engineer; Seawater Desalting Process, by V. J. Calise, The Permutit Co.; Water Treatment at Koppers United Co. Plant, by Paul J. Stein, H. W. Howe, and F. B. Varga of Koppers United Co.; Water Treating Problems in Steel Mills, by E. M. Griffith, Republic Steel Corp.; Water in the Paper Industry, by Lewis B. Miller; Lime and Lime Stone in Waste Pickle Liquor Treatment, by Richard D. Hoak and C. J. Lewis, Mellon Institute; Ozone as a Water Sterilizer, by N. P. Rand, Norwood Filtration Co.; and Use of Silicates for Coagulation, by H. R. Hay, Philadelphia Quartz Co.

ASA Approves New Standards For Electrical Industry

THE AMERICAN STANDARDS ASSOCIATION has just approved a fourth revision of the American Standard, Terminal Markings for Electrical Apparatus, the purpose of which is to keep the basic rules for identifying terminals in step with the newest accepted practices in the electrical industry. In this revision markings for capacitor motors with their many auxiliary devices and leads have been added. Several other sections have been augmented in this latest revision of the standard.

WPB Lifts Restrictions for Manufacture of Turbines

ANNOUNCEMENT has come from the War Production Board that due to the greatly increased demand for steam turbines in recent months, restrictions have been lifted on the use of auxiliaries and special equipment in the manufacture of turbines. Many of the petroleum and synthetic rubber projects that required large numbers of turbines have been completed and new facilities have come into production, permitting fulfillment of all marine programs requiring turbines, according to WPB officials. The manufacture, delivery and installation of steam turbines for land use however, remain subject to all other applicable WPB regulations and orders.

Lincoln Foundation Papers Placed in Library at O.S.U.

ANNOUNCEMENT comes from the Ohio State University that all papers submitted in the James F. Lincoln Arc Welding Foundation's $200,000 Award Program of 1937-38, and the Engineering Undergraduate Award and Scholarship Program of 1942-43, have been placed with the University's A. F. Davis Welding Library. There is a wealth of information in this collection which consists of approximately 1000 books on designing for welded construction, welding techniques and procedures, properties of weld metals, standard welding handbooks, metallurgy, also magazine articles, technical papers, patents and other literature contributing to the subject of welding.

SPECIAL CLEANERS FOR curved TUBES

All the requirements for cleaning curved tubes successfully are fulfilled by the Wilson E.C.T. Series Air Motor. It has the extra power and high torque necessary to remove heavy deposits without stalling; saving time, money and labor in tube cleaning.

Its small diameter, short length, and special armored flexible hose minimize possibility of jamming. When used with a universal joint, and radial expansion cutter heads or cleaners it will negotiate extremely short-radius bends. An exclusive valve design which makes full use of air with minimum back pressure, leakage and friction, together with its six-blade construction, provide smooth power and prevent stalling.

Consult the Thomas C. Wilson engineering staff on any difficult tube cleaning problem—or write for complete bulletin.

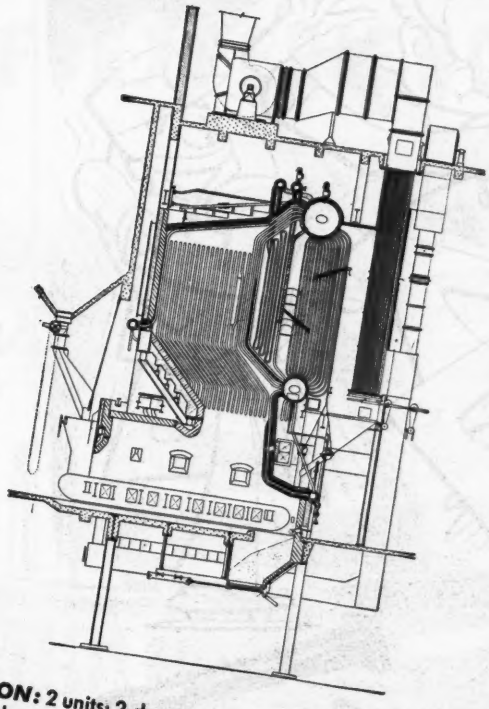
MODERN TUBE-CLEANERS FOR THE PROBLEMS OF TODAY

wilson

THOMAS C. WILSON Inc.

21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

EDGE MOOR WATER TUBE BOILERS



THIS INSTALLATION: 2 units; 2-drum, bent tube, with superheater, water walls, vertical tubular air preheater.

CAPACITY	75,000 lbs. steam per hour
DRUM PRESSURE	450 psi.
DEGREES OF SUPERHEAT	300
FINAL STEAM TEMPERATURE	750° F.

These boilers are equipped with chain grate stokers and Edge Moor vertical tubular air preheaters for the efficient burning of lighite fuel.

- Edge Moor Boilers are designed for any required capacity and up to 900 lbs. drum pressure. Complete steam generating units are available, including boilers, superheaters, water walls, economizers and air preheaters.

STEAM GENERATING EQUIPMENT

EDGE MOOR

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE: EDGE MOOR, DELAWARE

TEMPERATURE EXTREMES

REX-FLEX Stainless Steel Flexible Tubing *likes either end of the thermometer*

THE ability of REX-FLEX to withstand the effects of extreme heat or cold has enabled it to be used successfully where other types of tubing have not been entirely satisfactory. REX-FLEX has the corrosion resistance of stainless steel which permits it to handle most types of gases and liquids.

Because of its lighter weight, pressure tightness and extreme flexibility REX-FLEX has been widely used in aircraft. The experience gained in developing stainless steel flexible tubing should be helpful in solving your problem of conducting liquids and gases. Chicago Metal Hose Corporation engineers will be glad to help you adapt this versatile, flexible metal hose to your requirements, or suggest the type best suited. Write for complete information today.

Flexible Metal Hose for Every Industrial Use

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

Your Blueprint for
MORE POWER
starts with
OAKITE CLEANING

Unit Heaters Cleaned in Place Easily, Speedily

One way to assure top operating efficiency of your unit heaters is periodically to rid fins and coils of dirt, dust, oil and other insulating deposits.

No Dismantling Necessary

Do this work the quicker, EASIER Oakite way. Just apply recommended solution of Oakite Composition No. 20 by the Oakite Solution - Lifting Gun, Model No. 391, either by air or steam pressure. Mechanical pressure and fast-working detergent action rids equipment of all deposits in short order. Cleaned IN PLACE, no dismantling is necessary . . . units are quickly restored to normal efficiency.

New, FREE Report contains complete instructions for expediting this important maintenance task. Send for your copy TODAY!

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized cleaning*
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Get this 700 MILLION FEET OF EXPERIENCE...

on your pressure-tube problems

No manufacturer can produce enough pressure tubing to reach nearly 5½ times around the earth without acquiring a lot of valuable first-hand information on what it takes to match tubes to jobs for utmost dependability and economy under all kinds of operating conditions. This is just one way of measuring the experience that goes into the making and applying of every B&W Tube for steam generating and heat transfer equipment. It is reflected in their consistently uniform quality and dimensional accuracy and enviable performance service record in all types of equipment.

At B&W you get unbiased technical advice on pressure tubing requirements for B&W can furnish BOTH Seamless and Welded Tubes. In fact, nearly 20,000,000 feet of *welded* pressure tubing alone was supplied by B&W during the past 12 months.

Why not take advantage of B&W's wealth of experience, modern specialty tube mills and extensive research facilities next time you need pressure tubing?

B&W TUBES

ELECTRIC-RESISTANCE WELDED	SEAMLESS
Carbon steel grades	Complete range of carbon, alloy and stainless steels
Sizes: ¾ in. to 4 in. O.D.	Sizes: ½ in. to 8⅝ in. O.D.

THE BABCOCK & WILCOX TUBE COMPANY

WELDED TUBE DIVISION, ALLIANCE, OHIO — SEAMLESS TUBE DIVISION, BEAVER FALLS, PA.

TA-1298

B&W MAKES BOTH

MORE POWER for Tube Cleaning means MORE POWER for production

Roto Tube Cleaners can help you maintain maximum performance and efficiency of your tubular equipment with minimum expenditure of time and labor.

Designed with plenty of power for the toughest jobs, Roto cleans tubes quickly and thoroughly. With the Roto "one-man" Air Valve, no helper is required because control is right at the operator's fingertips.

Because you need to keep your plant in operation at top efficiency with a minimum of down time now, when maintenance crews are undermanned, it will be to your advantage to put Roto Tube Cleaners to work in your plant without delay.

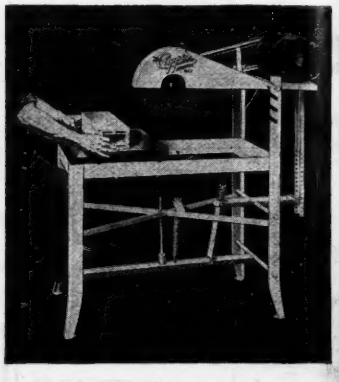
Full details on request.

The **ROTO** Company
Division of Elliott Company
145 Sussex Ave., Newark, N.J.

ROTO
Tube Cleaners

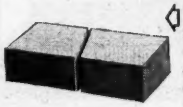
FASTER CUTTING ...with Clipper Masonry Saws

Your Special Size and Shape Brick or Tile can now be "Tailor-Made" at a moment's notice!



The new Clipper Multiple Cutting Principle makes possible faster cutting of every masonry material regardless of hardness.

Here are a few typical examples of the speed and accuracy with which fire brick can be cut for furnace repairs.



This acid brick intended for a chemical plant acid chamber was cut completely in two, in 37 sec.

One of many intricate cuts performed on first quality clay brick for heat treating furnaces. Made in 8 seconds.

Silica brick cut lengthwise for open hearth furnace work, only 9 seconds were required to complete this cut!

Basic refractories for steel furnaces or cement kilns must be accurately installed. This magnesite brick was cut in 12 seconds!

Clipper Saws are available for trial. Write for Descriptive Catalogs.

THE Clipper "SAWS RIGHT THRU" MANUFACTURING COMPANY

4018 MANCHESTER
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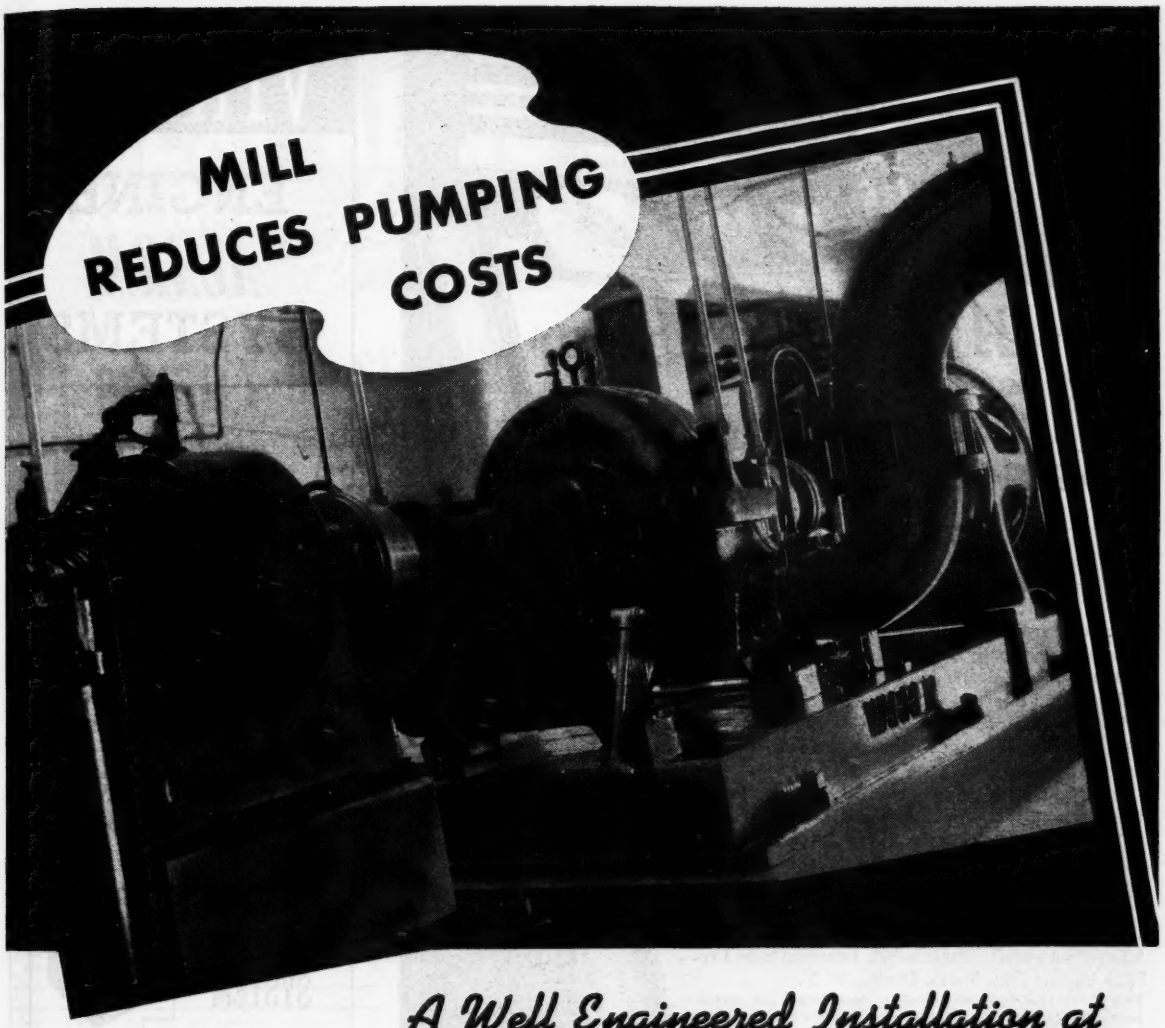
CLASSIFIED ADVERTISING

HELP WANTED

WANTED—Mechanical Engineer with good experience in modern Power Plant design to take charge of engineering department of Mechanical Contractor not engaged in or affected by war work. Should have experience in estimating Power Plant Piping and Layout work. Some construction experience and structural steel experience desirable but not absolutely necessary. Excellent opportunity for permanent position at good salary in well established business with advancement to executive position. Applicant should send preliminary information as to experience and salary to permit arrangement personal interview at Company's expense. Address Box 1454, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

SHIFT OPERATOR—S T E A M. Permanent job. Must actually know turbines, condensers, boilers, etc., of modern H. P. types and be capable of operating a small switchboard. Minimum of high school education. No boozers or boomers wanted. Man (and/or wife) must be entirely willing to live in a very small country town and not expect war time wages. If you are fully qualified and can get proper clearance thru U.S.E.S., write, giving full particulars, care Box 1456, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

GRADUATE MECHANICAL ENGINEERS. Power plants for steam electric stations; and also industrial applications. Experienced engineering, designs, specifications, cost estimates, heat balances, economic studies and preparation reports. Ability direct assistants. Location New York City. First reply must give full particulars, age, education, experience in detail, availability, draft status, salary, etc. Submit photograph which will not be returned. If now employed highest skill do not reply. Address Box 1455, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.



A Well Engineered Installation at

S. D. WARREN COMPANY, manufacturers of quality printing papers, Cumberland Mills, Maine . . .

assisted by a WARREN PUMP

Paper Mills place a premium on reliability and performance. At Cumberland Mills the plant hydraulic elevator pump has a dual drive turbine and synchronous motor.

The turbine driver is used to regulate heat balance and to supply process steam. Pump requirements are thus served with by-product power. The synchronous motor generates when the steam demand exceeds the pump load and operates as a motor when the demand is less. Pump power costs are reduced to a minimum.

In serving industry Warren not only builds pumping machinery for many important and widely diversified services but cooperates with plant engineers and operating executives in working out money-saving installations.

WARREN PUMPS

WARREN STEAM PUMP CO., INC.

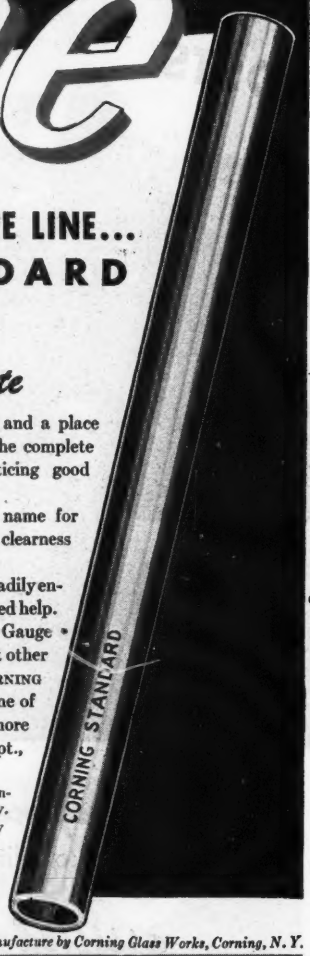
WARREN, MASSACHUSETTS

PYREX RED LINE
PYREX BROAD RED LINE
PYREX HIGH PRESSURE

One

OF THE COMPLETE LINE... CORNING STANDARD

For use where Pressures are Moderate



There's the spot for a CORNING Standard Gauge Glass and a place to save money too. By choosing this gauge glass from the complete CORNING Standard and PYREX Line you are practicing good judgment and economy.

The CORNING Standard Gauge Glass has earned a name for itself in moderate pressure service by its long lasting clearness and serviceability.

Its machine drawn accuracy means that you can more readily entrust its installation to your newest and most inexperienced help.

You're value-wise when you select CORNING Standard Gauge Glasses for those average pressure installations. To meet other operating conditions select the proper glass from the CORNING and PYREX complete line. You'll find that there is one of them to fulfill every different set of requirements. For more information write for Bulletin 817, Industrial Sales Dept., PF10 Corning Glass Works, Corning, N. Y.

PYREX brand High Pressure—resistant to thermal shock and mechanical shock and attack of steam and hot water. Machine drawn accuracy.
PYREX brand Red Line—Same but with added visibility afforded by enameled red line.
PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.
CORNING Standard—For moderate pressures. Long-lasting. Machine drawn accuracy.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

Waste Pipes Clogged Up?

"MILLER'S" Cleanout Tools are used all over the country by leading engineers for clogged up Drains, Gas Lines, Chemical Lines, Sewers and Toilets. This Miller unit is one of the most efficient ever produced. The high speed gear handle whirls a strong flexible rod through bends, angles, traps and elbows—driving through stoppages in a jiffy. It will use a ¼-inch, ⅜-inch, or $\frac{5}{16}$-inch rod and accommodate as much as 30 feet. Guaranteed to do the job.

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J. C. MILLER TOOL SALES
5914 Wilson Ave. Chicago 30, Ill.

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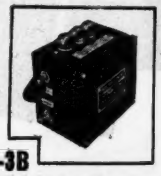
TYPE M CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

COMPLETE ALARM SYSTEM



TYPE M-3B

Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT

TYPE C CONTACT MAKERS

Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

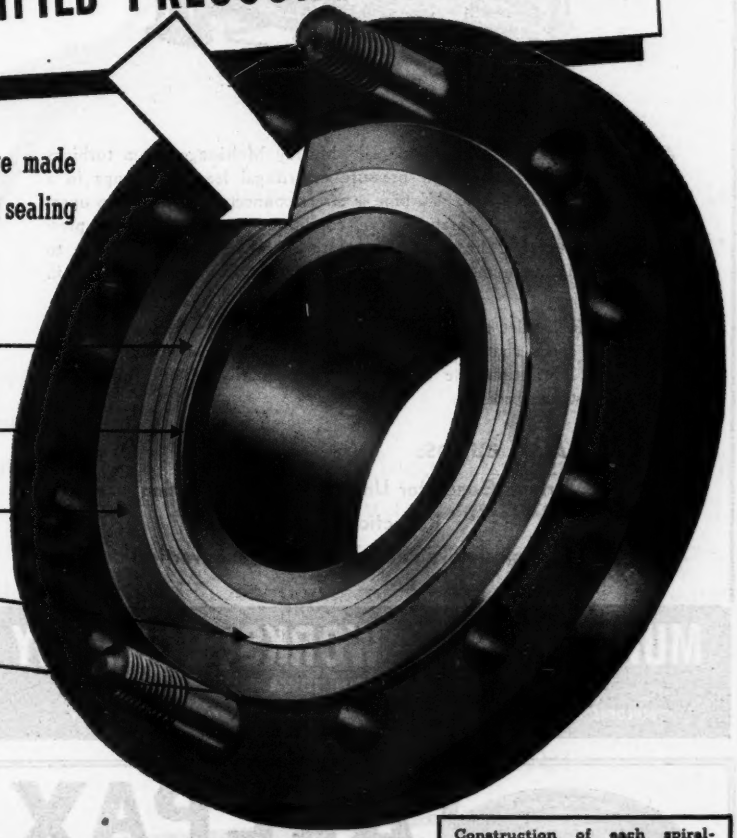
Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

VIKING INSTRUMENTS, INC.
483 Fairfield Ave., Stamford, Conn. Telephone 4-7315

FLEXITALLIC C-G GASKETS
ARE MADE *for* THE WORKING PRESSURE

DENSITY OF SEALING MEMBER IS CONTROLLED SO AS TO BE CORRECT FOR THE SPECIFIED PRESSURE OF THE LINE

Know how these pipe-flange gaskets are made and how they work. They'll do a great sealing job for you—as they now do in war



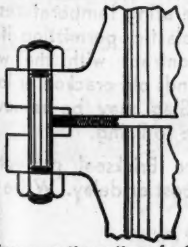
Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I.D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

Fit of surrounding ring, allows inner member to expand under compression.

Correct position assured by O.D. of gauge-ring which fits inside of bolts.



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

Construction of each spiral-wound member is governed by design of fittings and by the required bonding load for working pressure and temperature.

Gauge-ring saves installation time. Gasket is correctly installed when flanges are brought down to the ring in making up joint.

Representatives in Principal Cities

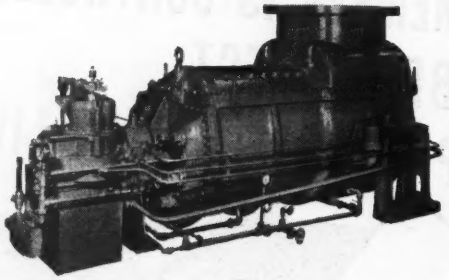
"Flexitallic" Reg. U.S. Pat. Office

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction

MURRAY

MULTISTAGE STEAM TURBINES



ONE of three 2000 HP Type UV Murray Multistage steam turbines furnished to drive high pressure centrifugal lean oil pumps in a Southwestern oil refinery. Turbine is direct connected to the pump operating at 3600 rpm. Operating steam conditions are 250 lbs. initial pressure, 500 degree Fahr. total temperature, exhausting condensing to 26 inches Hg. vacuum. A total of 14 Murray turbines are installed in this refinery.

Having 4 inch inlet flange, 30 inch exhaust flange, mechanical governor with hand speed changer, flexible pedestal type center-line support, and force feed lubrication, the machine is representative of our full line of multistage steam turbines.

MURRAY ALSO BUILDS:

Turbine Generator Units to 2500 KW Rating

Reduction Gears

Mechanical drive turbines—horizontal or vertical

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and

. . . you'll use it always

Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

THE ALLPAX CO., INC.

Mamaroneck, N. Y.

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Distributors Everywhere

BRICKSEAL

★Highly-glazed monolithic coating prevents cracking and spalling

Brickseal will reduce to a minimum the danger of untimely failure of boiler refractories. This widely-used refractory coating, applied like paint with brush or spray gun, forms a highly-glazed, heat-reflecting, monolithic, protective surface which prevents damage due to cracking, spalling, slagging, air infiltration and sudden temperature variations.

Brickseal should not be confused with ordinary air-set washes which form a plaster-like surface coating. Brickseal consists of high-fusion clays and metals combined in oils. Furnace heat burns the oils and vitrifies the clays and metals, which penetrate deeply into all pores, cracks and joints, binding the bricks into a durable, monolithic wall.

Brickseal cannot crack, blister or peel off due to sudden temperature changes because, at operating temperatures, it becomes semi-plastic, permitting it to expand and contract with the wall. Brickseal also binds old cracked or loosened bricks. Slag may be removed without damage to lining.

You can secure Brickseal protection with very little cost or delay. Write for sample today.

BRICKSEAL

REFRACTORY CO.

1029 CLINTON ST., HOBOKEN, N. J.

TO THOSE WHO ARE ASKING THIS QUESTION:

How soon can boiler plants be modernized?

THE ANSWER IS *RIGHT NOW* . . . if the oil or gas burning equipment you are using wastes fuel, or is incapable of producing maximum boiler rating. Hundreds of plants throughout the country already have modernized their costly, inefficient boiler rooms by the installation of Todd burners. And today Todd engineers are cooperating with the owners of many others on plans for modernization.

The importance of power plant efficiency is emphasized by today's need for peak war production. Todd liquid and gaseous combustion equipment conserves fuel, steps up power production—and thereby cuts the cost of a pound of steam.

Commercial and industrial plants using Todd burners report fuel savings ranging up to 10% and more, and corresponding power increases. Efficient boiler room operation will be a factor of special importance in the competitive years ahead. That's why forward-looking power engineers know that NOW IS THE TIME TO MODERNIZE—WITH TODD!

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COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
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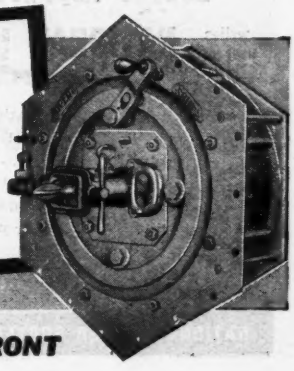
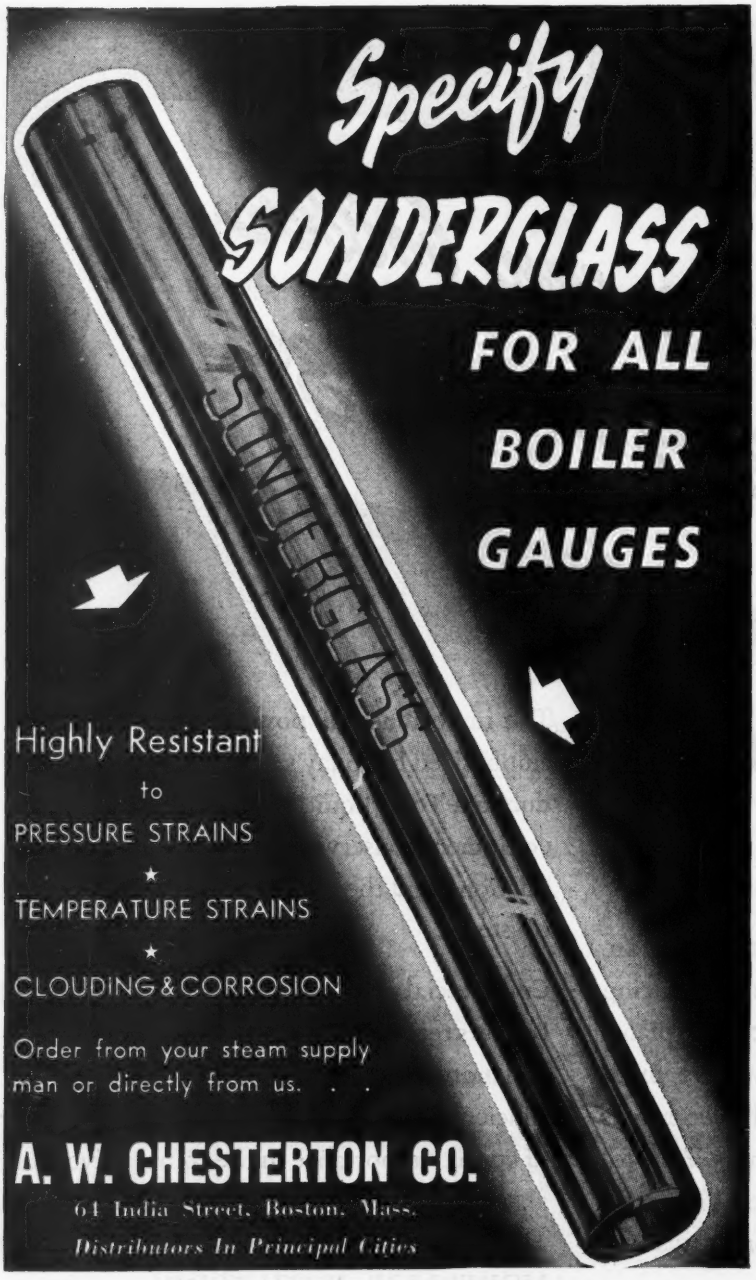


ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

Specify SONDERGLASS FOR ALL BOILER GAUGES



Highly Resistant
to
PRESSURE STRAINS
★
TEMPERATURE STRAINS
★
CLOUDING & CORROSION

Order from your steam supply man or directly from us. . .

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New conveniences in this second edition of the well-known "Vapor Charts" include an entirely new form of chart for steam and water mixtures having qualities less than 80 per cent; a redrawing of plates 8 and 9 to include the pressure scale for the saturated liquid; addition of scales to the ammonia and freon charts to give the specific volumes of the saturated liquids. To enable the enthalpy-volume charts for steam to be used more conveniently the page numbers of the adjoining plates have been added on the margins of each plate.

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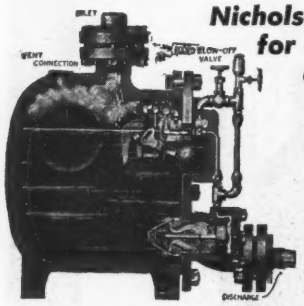

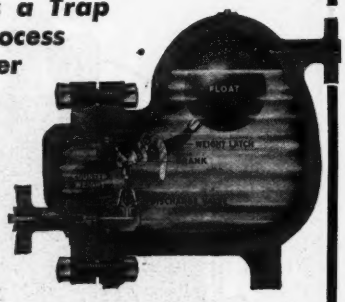

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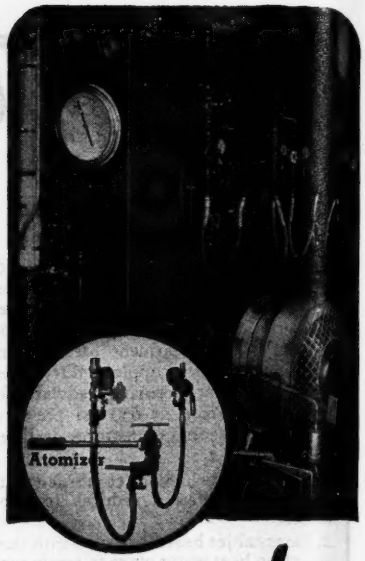

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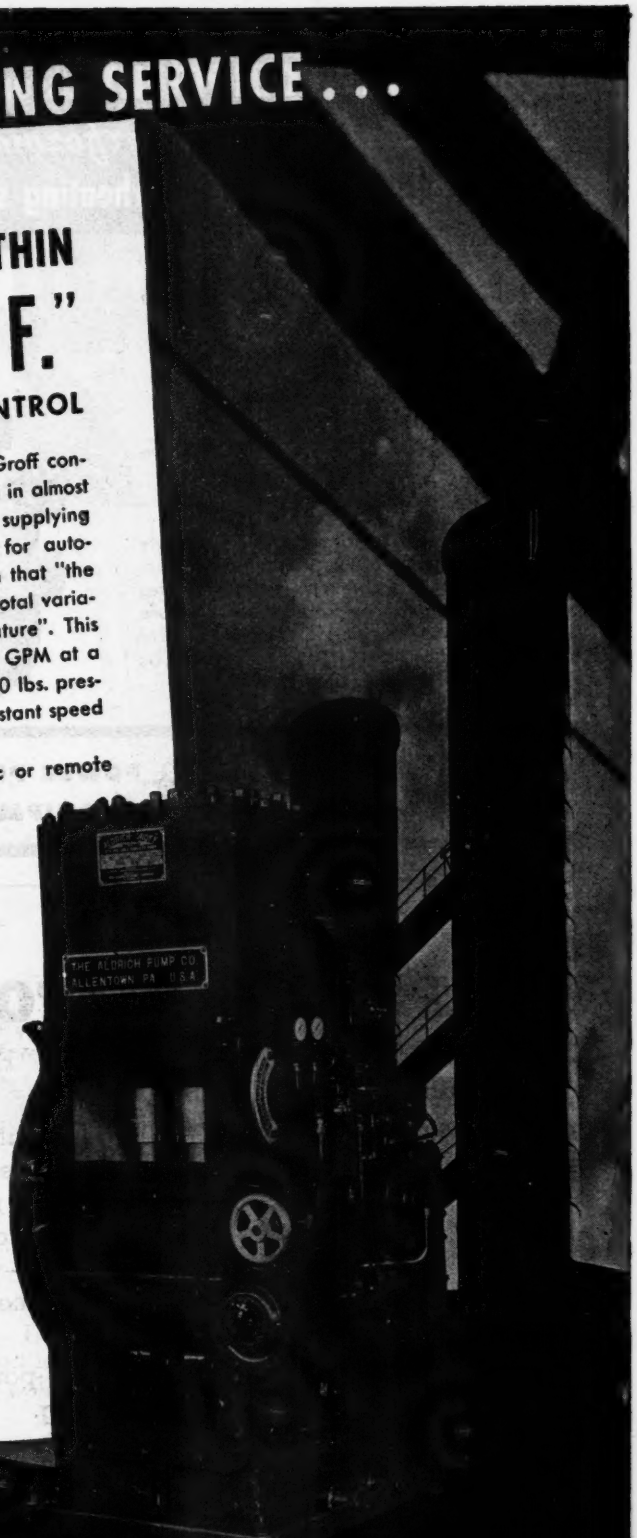

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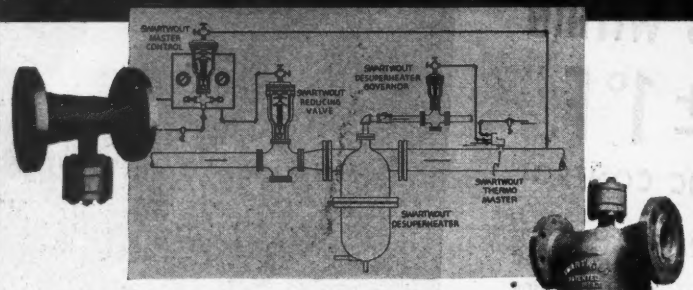

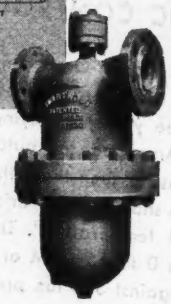

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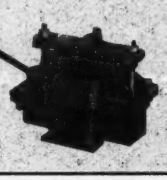

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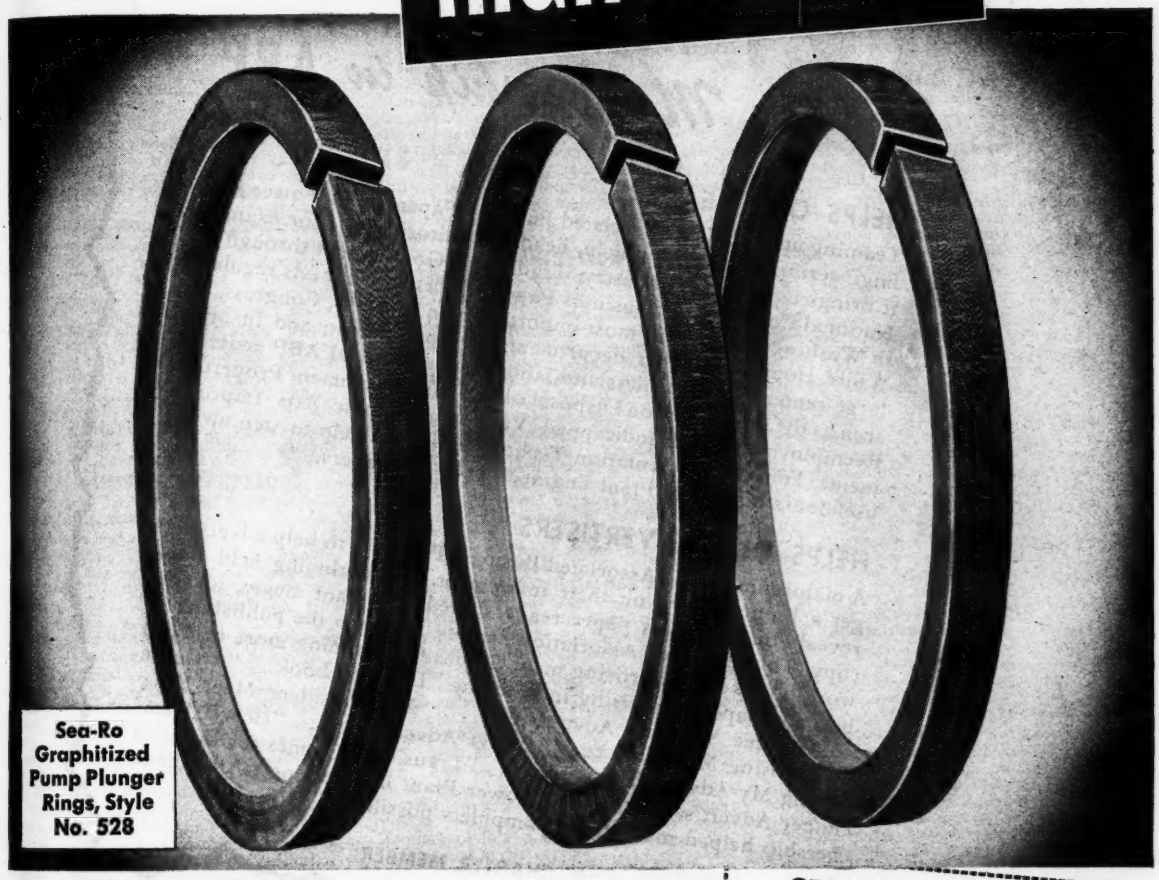

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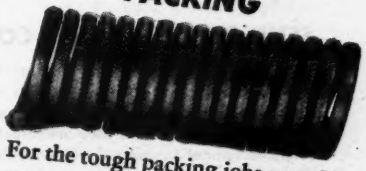

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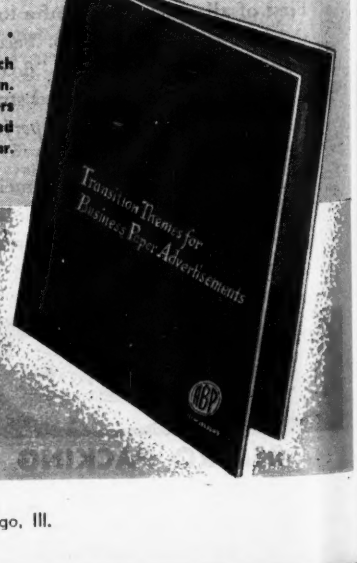

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Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

ELECTRICAL

1 Speedy Panelboard Conversion—New 16-pg Booklet CA-575 describes a speedy method of converting obsolete light and power panelboards to give greater capacity, safety and efficiency without disturbing the box or conduit. Booklet is illustrated with "before" and "after" illustrations. Square D Co.

2 Motor Maintenance Handbook—"Hints to Make Motors Last" is the title of handy little booklet for engineers and maintenance men. Check chart tells what to do when motor fails to start, runs hot, is noisy, shows excessive brush wear, etc. Westinghouse Electric & Mfg. Co.

3 Aids for Selection of Instrument Transformers—New 56-pg booklet, "Instrument Transformer Accuracy Standards," has been issued by the General Electric Co. Several tables and graphs simplify the use of Part 1 in respect to classifying transformers for accuracy, evaluating the effects of transformer errors on meter readings. Second part is a handy guide for the selection from a complete line of standard indoor and outdoor current and potential transformers; contains prices, ratings, and ASA and NEMA accuracy classifications for each type.

FANS, PUMPS, COMPRESSORS

4 Pumps for Process Industries—Bulletin WP-1099 describes Worthington centrifugal pumps for corrosive liquids, steam-jet ejectors, power pumps, Diesel and gas engines, steam turbines, refrigeration equipment for process industries. Worthington Pump and Machinery Corp.

5 Keeping Water Out of Compressed Air—Literature tells how controlled temperature cooling with the Niagara Aero After-cooler keeps water and oil out of compressed air lines. Condenses the moisture before it gets into lines; also provides jacket water of proper temperature to prevent condensation in compressor. Niagara Blower Co.

6 Hydraulic Handbook—60-pg Aldrich Bulletin 50 contains authoritative hydraulic information and tables, under headings: Water head equivalents, Pump plunger loads, Hydraulic formulae, Plunger displacement, Pressure equivalents, Capacity of shafts, Electrical data, Pump discharge diagrams, Accumulator volumes, Friction losses in fittings and pipes, Capacities of Pumps and Cylinders, Pipe data, etc. The Aldrich Pump Co.

7 Handbook On Centrifugal Pumps—Allis-Chalmers' pump maintenance handbook gives a grand "refresher" course in alignment problems, figuring head, making shafts last longer, preventing cavitation, etc. Applies to all makes of pumps. Allis-Chalmers Mfg. Co.

INSTRUMENTS AND CONTROLS

8 Liquid Level Indicator—How the Yarway remote liquid level indicator gives quick, accurate readings down at convenient eye level is described in new bulletin. Yarnell-Waring Co.

9 Air-operated Controllers—Bulletin No. A115, describing a new line of air-operated controllers, known as the Model 93 series, is offered by The Bristol Co. Helpful information is given about the instruments for control of temperature, pressure, vacuum, liquid level, humidity, and flow.

10 Ring-Balance Flow Meters—How meter capacities may be changed by adding range weights, without taking meter out of service, and other features of ring-balance mechanical flow meter are described in Bulletin T44. Ring Balance Instrument Co.

11 Electronic Heat Controller—Technical information and installation data on the Johnson electronic duo-stat heat controller are given in Bulletin No. 396A. Contains hookups for stokers, gas burners and other firing devices; performance charts and tips for heating engineers. Johnson Service Co.

12 Meters for Steam, Air, Gas—Bulletin 349 tells about the simple design, compact construction, easy installation of shuntflo meters. Contains sectional views, capacity charts and other useful data. Builders-Providence Co.

13 Steam Pressure Control—Bulletin C1 tells about the accuracy, flexibility and compactness of the Fisher Type 92 automatic controller for steam pressure regulation. Ten sizes. Fisher Governor Co.

LUBRICATION

14 Constant-Level Lubricators—Oil-Rite Corp. leaflet gives construction, operation and installation data on Style J heavy-duty constant-level lubricators. Used for electric motors, pillow blocks, pumps, gear boxes, fans, etc.

15 Lubrication of High-Up Bearings—Ending hazards due to manual lubrication of high-up and hard-to-get-at bearings on presses, cranes and other "off the floor" types of equipment is subject of bulletin issued by The Farval Corp. under title "Aloft is no Place for A.W.O.L. (absent without lubrication) Bearings." It explains application of Farval system for sending lubricant under pressure from a central pumping unit to every bearing.

16 Centralized Lubricating Systems—New booklet describes the Alemite LubroMeter, a simple form of centralized lubrication which has only two moving parts in its valves, and satisfactorily handles both oil and grease. It can be used over a wide range of temperatures; serviced from hand or power operated portable type guns. Alemite Div., Stewart-Warner Corp.

17 New Lubrication Plan—Sun's Save-and-Serve Plan has been developed to make equipment last longer through correct lubrication. Includes plant poster, wall chart, helpful lubrication manual, technical bulletins, maintenance memos. Sun Oil Co.

18 "Diesel Operation and Lubricants"—This 80-pg catalog of charts, diagrams, illustrations and text help Diesel engineers and executives in meeting lubrication problems. The Texas Co.

PIPING, VALVES FITTINGS

19 Flexible Metallic Interlocked Hose—New 12-pg bulletin has latest engineering data about Penflex galvanized steel hose and bronze steam hose with couplings. Illustrated. Pennsylvania Flexible Metallic Tubing Co.

20 Safety Valves—Bulletin 501-A, by J. E. Lonergan Co., is an interpretation of the new Safety Valve Standards developed under W. P. B. and National Bureau of Standards auspices. Tables I, II, and III summarize the sizes, connections, service limits, and other standard specifications set up for each type of valve. Lonergan designs corresponding to the official standards are described and illustrated. Miniature "blueprints" of each design are included.

21 Welding Fittings—As much a text book as a catalog, 216-pg presentation gives a wealth of information on welding fittings and forged steel flanges. Contains engineering data that will prove invaluable to the man who purchases, designs or specifies piping, fittings and flanges in carbon and alloy steels. Taylor Forge & Pipe Works.

22 Blow-off Valves—Featured in Catalog No. 40 are Okadee blow-off valves, widely used in power plants, oil field boilers, laundries, heating plants, etc. Advantages include straight through blow, one-piece body, full opening. The Okadee Co.

23 Pressures on Welding Fittings—A 20-pg booklet issued by Tube Turns, Inc. gives allowable working pressures for welding fittings in five classes of piping—power, oil, district heating, gas and air, and refrigeration. Fourteen convenient tables list allowable pressures at the indicated temperatures for any size and weight Tube-Turn fitting.

PRIME MOVERS

24 Steam Engine Data—Bulletin No. 306 gives sectional drawings, construction details and operating information on Troy-Engberg steam engines; discusses savings possible with by-product power. Troy Engine & Machine Co.

25 Mechanical Drive Turbines—Elliott mechanical drive turbines, type CY, with built-in reduction gearing, are discussed in a new 4-pg Bulletin H-15. The single-stage mechanical drive turbine with built-in reduction gear combines the standard Elliott CY turbine with a specially built vertically-offset gear. This combination eliminates the turbine exhaust-end bearing and coupling by supporting the combined turbine and pinion shaft on three sleeve type bearings. Elliott Co.

26 Turbine Cleaning Manual—Well-illustrated 18-pg handbook gives tips on inspection and cleaning of turbines. Covers tanks, sumps, coolers, gear housings, bearings, governors, etc. Shell Oil Co., Inc.

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OCTOBER, 1944

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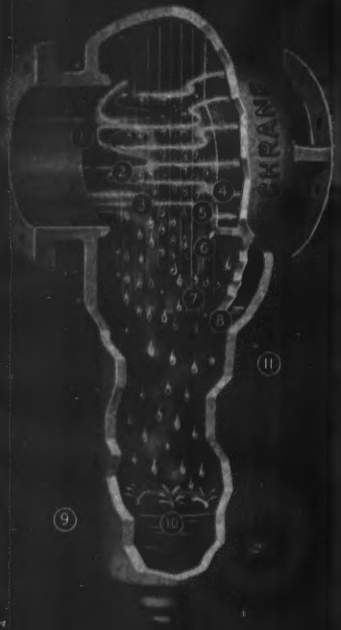

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WATER TREATMENT

27 **Carbonaceous Zeolite Softeners**—Cochrane's new publication 4021 offers helpful data in determining applicability of this system to water conditioning problems. Contents include: Chemical reactions, sodium cycle softening, blending, typical analysis. Cochrane Corp.

28 **Induced Draft Cooling Towers**—New Marley Bulletin No. 700-A describes operating advantages and pictures typical installations of Marley double-flow horizontal induced draft cooling towers. Contains many useful graphs and sectional views. The Marley Co., Inc.

29 **Hot Flow Water Softeners**—How Infilco hot-flow softener provide the mechanical means for the chemical treatment of water heated virtually to steam temperature is explained in Bulletin 1850. Contains helpful diagrams and installation photos. Infilco, Inc.

30 **Water Conditioning System**—New bulletin describes the technical water conditioning system which provides individual formulas to fit every water type. Said to provide a special balance of water properties that overcome scale, foaming, pitting, corrosion, caustic embrittlement. Water Treatment Co. of America.

31 **Double-Check Zeolite Softener**—Elgin Softener Corp. in Bulletin 606, describes an improved water softener which, compared to others of equal size, is said to give up to 44 per cent more soft water. Equipped with new manifold arrangement which prevents loss of zeolite.

MISCELLANEOUS

32 **Tough Floors for Tough Service**—How Ferem "blue temper" floors resist shock, abrasion, water and corrosion in power plant and factory floors is explained in new illustrated folder. A. C. Horn Co.

33 **Fire Extinguisher Maintenance**—Latest addition to the manuals published by Walter Kidde & Co. is entitled "Inspection and Maintenance of First Aid Fire Extinguishers." This helpful 12-pg booklet is written in language the plant foreman or fire chief can easily understand, and is illustrated with drawings, photographs and simple charts.

34 **Hookups On Heat Recovery Silencers**—Typical hookups show how Maxim heat recovery silencers make use of the engine exhaust heat to provide steam or hot water for heating or processing operations in usable volume. The Maxim Silencer Co.

35 **Gearmotor Applications** — New handbook "Gearmotor Applications" tells about high efficiency (98 per cent in single reduction unit), ease of installation, compactness, and other features of Westinghouse gearmotors.

36 **Fuel Oil Heater**—How Paracoil heaters deliver fuel oil to the burners at a definite and uniform temperature is described in illustrated Bulletin No. HE-100. Davis Engineering Corp.

37 **Unit Heaters**—Bulletin 41-A gives construction details and ratings on Chromalox unit heaters—widely used for factory offices, stock rooms, substations, pump houses, valve houses, oil and fuel storage rooms and other isolated or hard-to-heat places. Edwin L. Wiegand Co.

38 **Heavy-Duty Heaters**—Construction features and operating advantages of Sturtevant heavy duty heaters are given in new Catalog No. 462. Contains heater piping hookups, capacity tables, temperature charts and other data of value to engineers with heating problems. B. F. Sturtevant Co.

39 **Stopping Masonry Leaks**—How Flexite stops direct leaks quickly in concrete vats, retaining walls, engine rooms, cable pits, etc., is explained in new folder. This liquid chemical works without removing water pressure. Flexrock Co.

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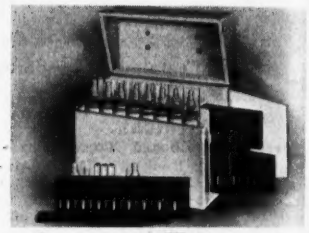

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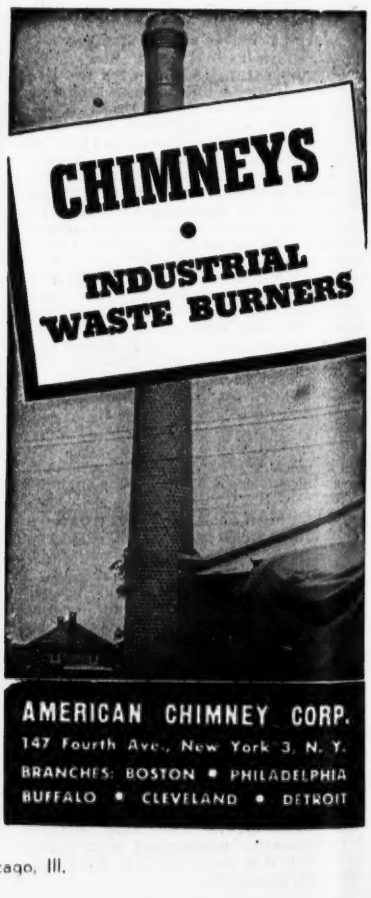

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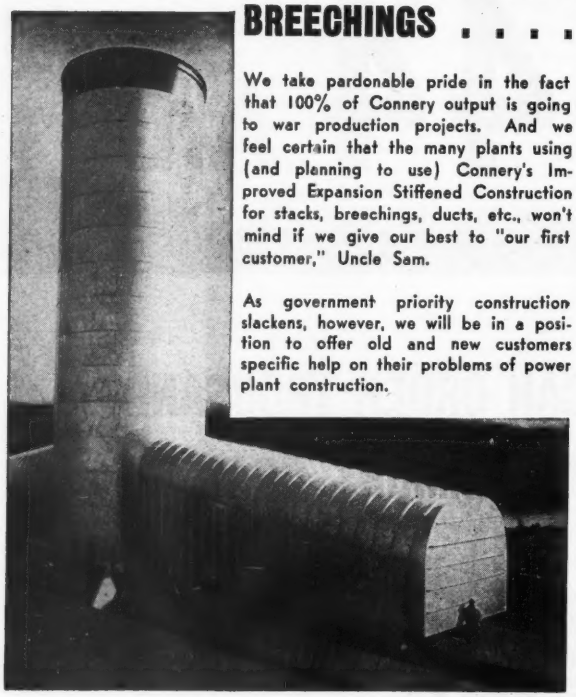

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Power Plant Construction News

Ark., Hurricane Creek—General Chemical Co., 40 Rector St., New York, N. Y., manufacturer of heavy chemicals, acids, etc., plans installation of electric power equipment in new plant at Hurricane Creek, for production for Government. Cost about $450,000, with financing in that amount to be provided by Defense Plant Corp., Washington, D. C., Federal agency. Work is scheduled to begin soon.

Calif., Fresno—Superior Olive Products Co., Tulare and Clovis Aves., plans installation of electric power equipment in connection with proposed rebuilding of portion of processing and packing plant, recently damaged by fire with loss reported close to $85,000.

Calif., San Diego—Consolidated Vultee Aircraft Corp., 3302 Pacific Highway, plans installation of electric power equipment in connection with expansion in plant for production for Government. Cost about $280,000. Financing will be provided by Defense Plant Corp., Washington, D. C., Federal agency. Work scheduled to be carried out at once.

Conn., Bridgeport—Housing Authority of City of Bridgeport, 252 Hallett St., plans installation of equipment in central-heating plants at Yellow Mill Village, Marina Village and Success Park housing developments for conversion from coal to oil fuel. Cost estimated about $123,000, and fund in that amount has been authorized. Proposed to begin work soon.

Ind., Richmond—Municipal Electric Lighting & Power Department, 32 South 8th St., plans improvements in municipal steam-electric generating station, including new cooling tower and other work. Cost reported close to $60,000.

Ind., Zionsville—Pitman-Moore Co., 1200 Madison Ave., Indianapolis, manufacturer of drug and pharmaceutical products, plans installation of electric power equipment in new two-story addition to plant at Zionsville. Cost reported close to $80,000. Work will begin soon. Bevington, Taggart & Fowler, Inc., Indiana Pythian Bldg., Indianapolis, is engineer.

Kan., Coffeyville—Municipal Water and Light Department, City Bldg., is considering a postwar expansion and improvement program at municipal steam-electric generating station, including installation of new boilers, turbine-generator and auxiliary equipment, to cost close to $900,000. It is understood that an engineer will be selected to make surveys and prepare plans at early date.

Kan., Wichita—Cardwell Mfg. Co., South Wichita St., manufacturer of oil field winches and other oil well equipment, plans new one-story addition, about 100 x 325 ft, reported to cost over $90,000, with machinery. Electric power equipment will be installed. It is understood that project will have a priority rating.

La., Logansport—Southern Natural Gas Co., Watts Bldg., Birmingham, Ala., plans extensions and improvements in gas compressor plants at Logansport and Perryville, La., used in connection with pipe line transmission system, with installation of additional equipment for increased capacity. Cost estimated close to $75,000.

Mich., Detroit—Detroit Public Lighting Commission, 174 East Atwater St., plans new power plant for city service in Waterworks Park, as a post-war development. Installation will include a 35,000-kw turbine-generator unit, high-pressure boilers and auxiliary equipment. Cost reported over $4,000,000. Smith-Hinchman & Grylls, Inc., Marquette Bldg., Detroit, and Burns & Roe, Inc., 233 Broadway, New York, N. Y., are consulting engineers.

Mich., Detroit—Dodge Division, Chrysler Corp., 7900 Joseph Campeau Ave., plans installation of electric power equipment in new one-story addition to main automobile works, to be known as Building No. 415. Cost reported over $250,000, with machinery. Erection is scheduled to begin soon.

Minn., Winthrop—Tri-County Dairy Co-operative, Inc., Winthrop, Leo Schaefer, president, plans installation of electric power equipment in new local central milk-dehydrating plant, to be one and two-story, about 85 x 140 ft. Work on superstructure will begin soon. Cost about $300,000. Klinger, Hubbard & Gohn, 218 South Barstow St., Eau Claire, Wis., are architects.

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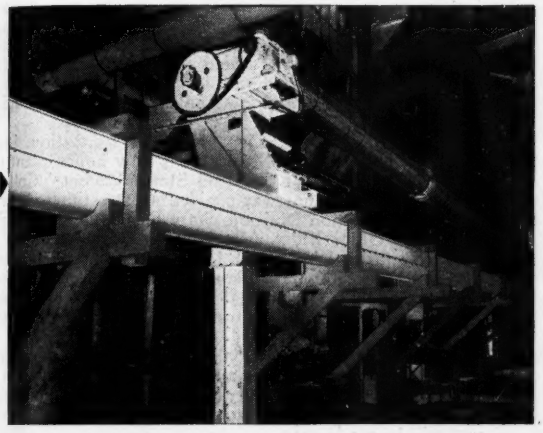
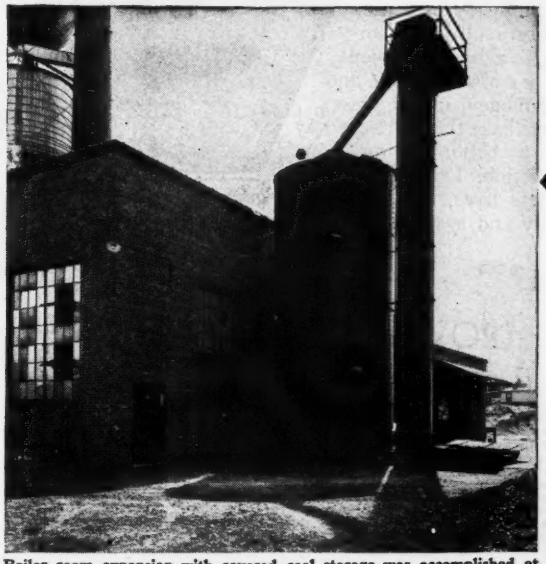
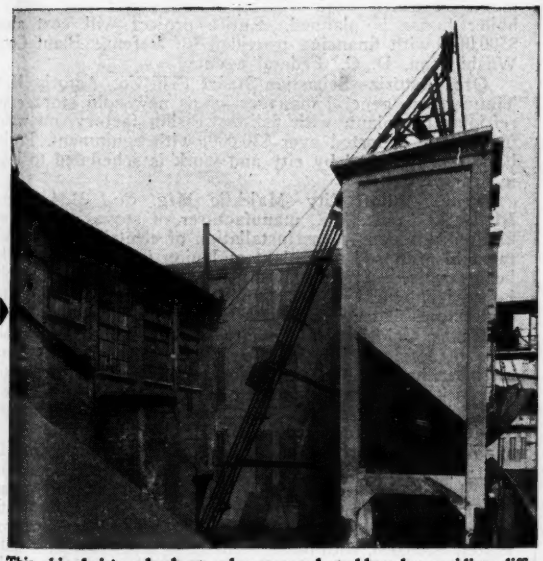


A combination Bulk-Flo elevator-feeder and horizontal screw conveyor which delivers coal from storage pile outside of boiler room, direct to boilers. This equipment replaced a time and labor-wasting practice of carting coal in wheelbarrows and firing by hand.



Boiler room expansion with covered coal storage was accomplished at this laundry without enlarging or raising roof of building or bunkers. Link-Belt elevator takes coal delivered by truck to silo with 20 ton live and 80 ton dead storage. Coal is spouted direct to boilers from this silo.



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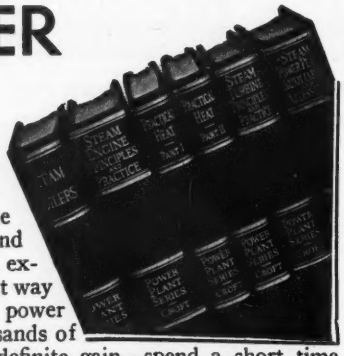

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Miss., Meridian—East Mississippi Electric Power Assn., Meridian, plans extensions in rural electric system in parts of Clarke and Lauderdale Counties, including service connections and other operating facilities. Cost estimated about $100,000. Financing has been arranged through Federal aid.

Mont., Great Falls—Great Northern Railway Co., Great Northern Railway Bldg., East Fourth St., St. Paul, Minn., plans one-story shop at Great Falls, for repair and maintenance of Diesel locomotives. Electric power equipment will be installed. Cost reported about $200,000. Company engineering department, first noted address, is in charge.

Mo., St. Louis—National Foundry & Machine Co., 8025 South Broadway, plans installation of electric power equipment in connection with proposed rebuilding of portion of plant, recently destroyed by fire, with loss reported over $200,000. Application will be made soon for a priority rating.

Neb., York—York County Rural Public Power District, York, has plans in progress for extensions in primary and secondary lines in parts of York County, with power substation facilities, service connections, etc., to be carried out as a postwar project. Cost about $200,000. Financing has been arranged through Federal aid. Henningson Engineering Co., Standard Oil Bldg., Omaha, Neb., is consulting engineer.

N. Y., Cortland—State Department of Education, State Education Bldg., Albany, N. Y., plans new boiler plant for central-heating service at Cortland State Teachers' College, to be carried out as a postwar project. Cost estimated about $185,000. Construction Division, State Department of Architecture, State Office Bldg., Albany, is preparing plans.

Ohio, Newark—Water and Light Department, 6 North Fourth St., has preliminary plans under way for extensions and improvements in municipal steam-electric power plant, as a postwar project. Cost estimated about $85,000 with equipment.

Okla., Kingfisher—Municipal Light Department is considering a postwar expansion and improvement program at municipal steam-electric power plant, including installation of equipment for increased capacity. Details and estimates of cost will be made soon.

Okla., Miami—B. F. Goodrich Co., 500 South Main St., Akron, Ohio, plans installation of electric power equipment in new rubber mill at Miami, for production for Government, on which work will be placed under way soon. A boiler house is planned. Entire project will cost about $500,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency.

Ore., Astoria—Sebastian-Stuart Fish Co., Astoria, H. C. Timmerman, general manager, plans new cold storage and refrigerating plant, with fish-processing factory, on waterfront. Cost reported over $70,000, with equipment. Project has been approved by city and work is scheduled to begin in near future.

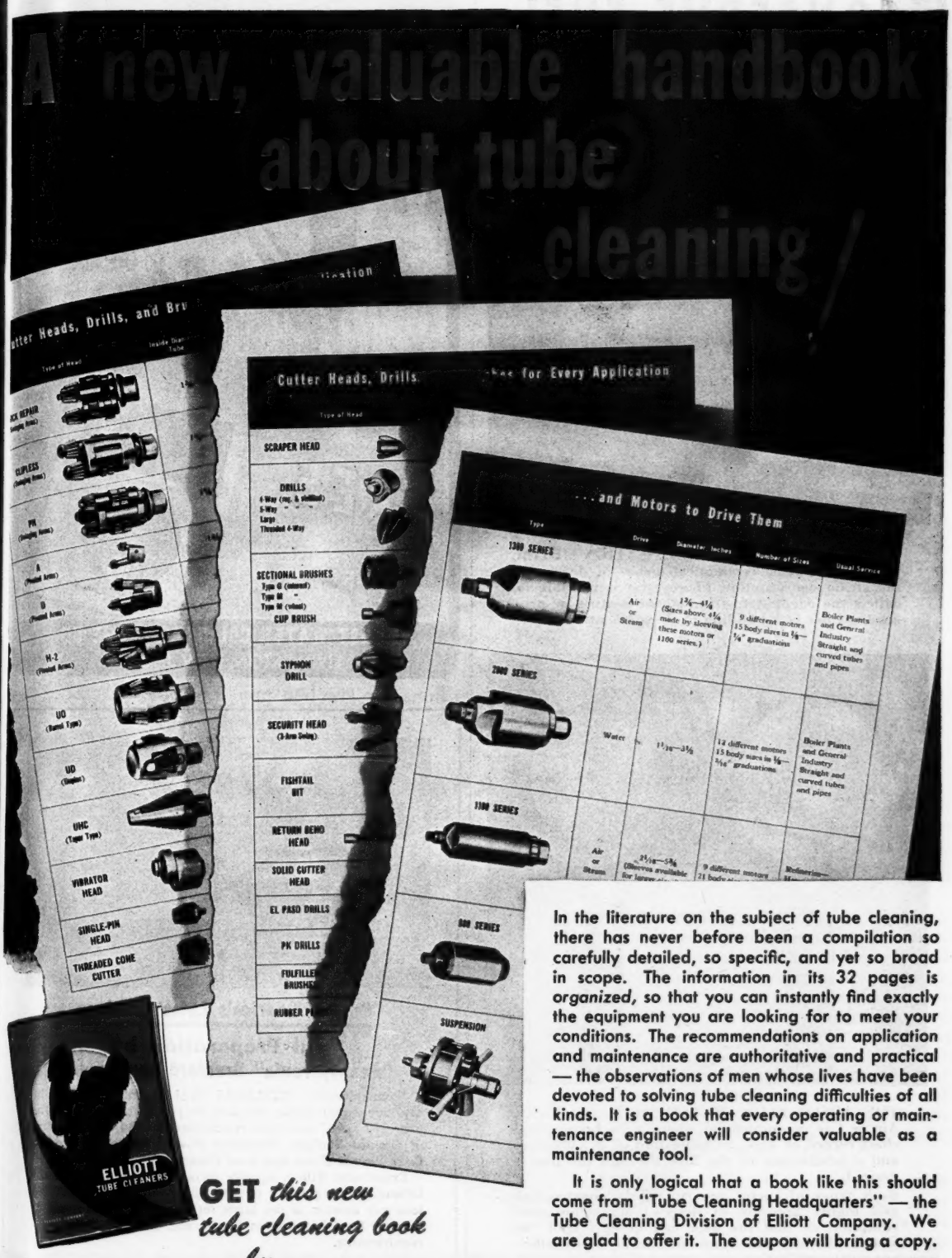
Tenn., Union City—Majestic Mfg. Co., 2134 Delmar Blvd., St. Louis, Mo., manufacturer of stoves, ranges and kindred products, plans installation of electric power equipment in proposed new plant at Union City, where site has been acquired. It will comprise several buildings. A boiler house is planned. Cost estimated close to $500,000. It is understood that this will be a postwar project.

Texas, Goldthwaite—County Locker Corp., Goldthwaite, care of Paul G. Bentley Co., Burt Bldg., Dallas, Texas, engineer, has plans maturing for new frozen food processing and locker plant, to be one-story, reported to cost close to $40,000, with refrigerating machinery and other equipment. Project will have a priority rating.

Wash., Brewster—Bonneville Power Administration, Department of Interior, 811 N. E. Oregon St., Portland, Ore., has plans under way for construction of new 115,000-v transmission line from Grand Coulee hydroelectric generating station to Brewster, about 44 miles. Cost estimated approximately $500,000, with power substation and switching station facilities. Application has been made for a priority rating.

Wash., Tacoma—St. Regis Paper Co., Kraft Pulp Division, Tacoma, plans installation of electric power equipment in proposed new paper mill and bag-manufacturing plant in vicinity of local sulphate pulp mills, to be carried out as a postwar project. Plant will comprise several large multi-story units and is reported to cost about $3,000,000. Main offices are at 230 Park Ave., New York, N. Y.

Wis., Janesville—Wisconsin Soybean Corp., care of Henry Traxler, City Hall, president, recently organized, plans installation of electric power equipment in new soybean processing mill on site acquired near intersection of South Pearl and Galena Sts., comprising several one-story units. Cost estimated about $95,000. A priority rating has been secured and work will begin soon.



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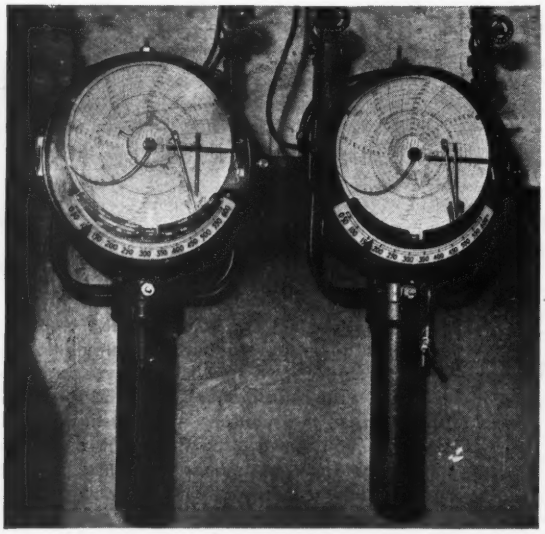

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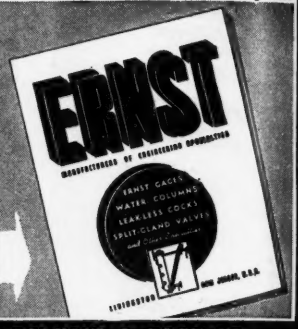

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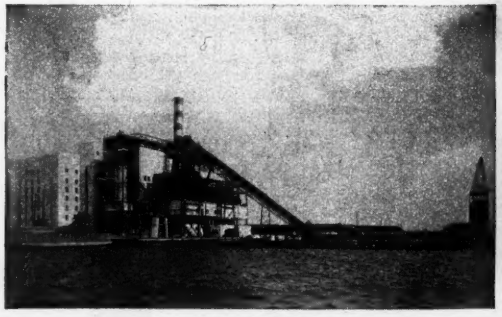

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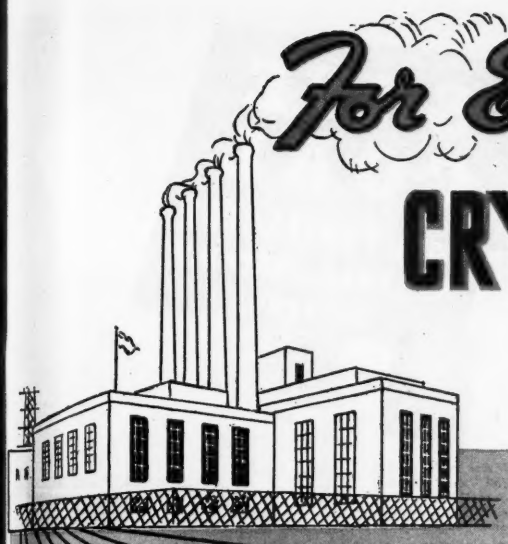

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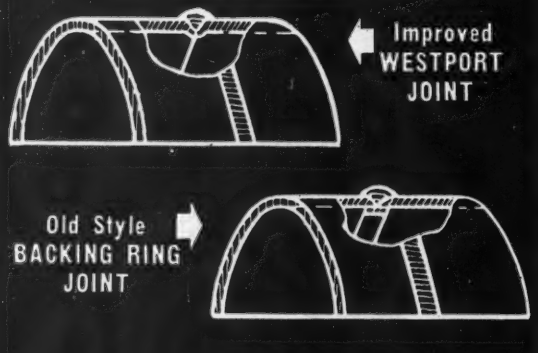

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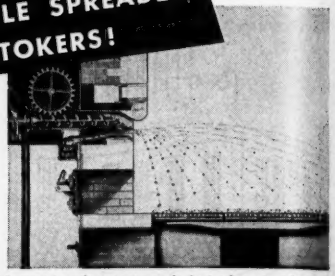

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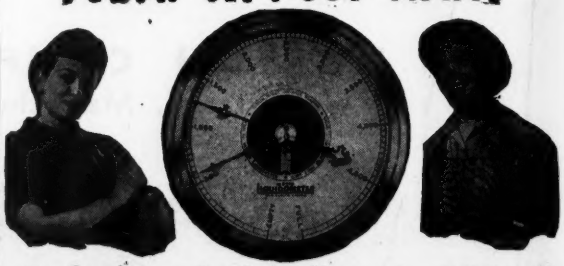

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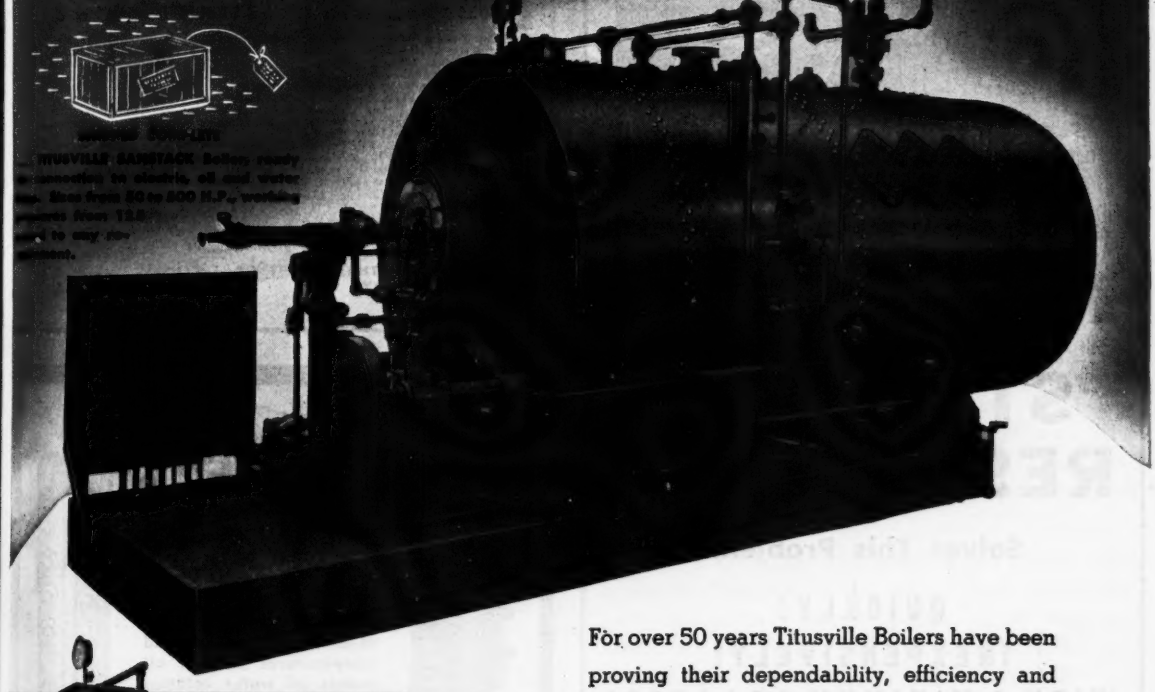

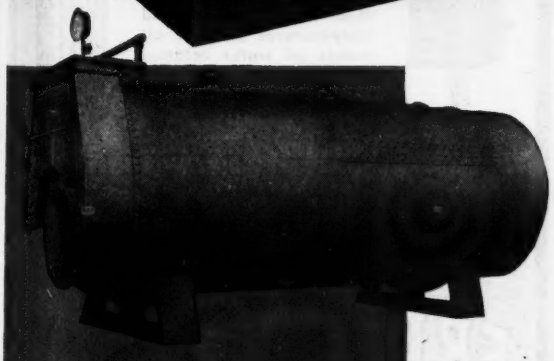

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A handy NEW tool for instant measurement of pipe, electrical conduit or thin-wall tubing in any position.

- Pocket-Size
- Unbreakable
- Fool-Proof
- Easy to Handle

Place smaller curved contacts against contour of pipe or electrical conduit — then turn larger contact until it touches pipe. Marker registers Standard Sizes of Conduit or Tubing, also Correct Size of Pipe, in terms of inside measurement. Another Scale shows Exact Drill Size for Tapping.

ACCURATELY MEASURES ALL SIZES OF PIPE and CONDUIT from ⅛" to 12" and TUBING from ½" to 2"

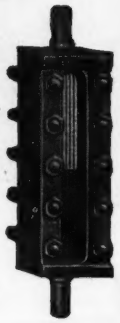
The 3-point Gage registers correct size instantly by determining outside arc of the pipe, or conduit at three points of contact. Marker shows also EXACT DRILL SIZE FOR TAPPING. A third scale shows standard sizes of Metallic (Thin-Wall) Tubing. Gage also contains handy inch rule and metric rule. Will accurately measure pipe in any position—in a corner, or against a wall. Can be used on covered pipe, too, if there is a small opening near union or other fitting where Gage can be slipped in. Can be applied in dark places and taken to light for reading.

● CONVENIENT VEST-POCKET SIZE—2¾"x4½". Light weight, sturdily constructed of black rust-proofed steel with large, deep-etched white numerals, easy to read—will not rub off. Patented in U. S. and Canada. Jobbers and dealers write for prices.

Price, each **$1.50**
With leatherette case **$2.00**

We will ship postpaid for checks or money orders—or C.O.D. plus postage and charges

THREE-POINT GAGE CO.
3825 BROADWAY CHICAGO 13, ILL.



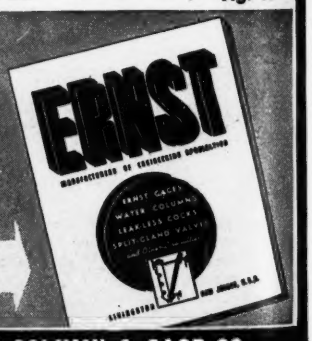
ERNST
FLAT GLASS INSERTS

Made for all pressures and temperatures and for all makes of water columns and boilers.

"C-BLACK" Prismatic Flat Glass Inserts — Fig. 37

"C-Clear Thru" Flat Glass Inserts — Fig. 45

TO HELP YOU KEEP BOILERS SAFE . . .
FREE
BOILER SPECIALTY CATALOG No. 45

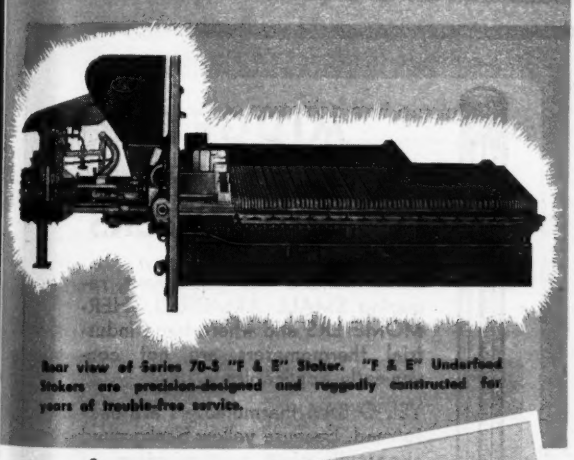


ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, NEW JERSEY

"F & E" Stokers

HANDLE HEAVY DUTY JOB FOR PENNSYLVANIA SANITARIUM

TWO SERIES 70-S UNDERFEED STOKERS HAVE PROVIDED UNINTERRUPTED FIRING FOR 4 YEARS AT LEECH FARM TUBERCULOSIS SANITARIUM, PITTSBURGH, PA.



Rear view of Series 70-S "F & E" Stoker. "F & E" Underfeed Stokers are precision-designed and ruggedly constructed for years of trouble-free service.

Just one glance at the plant that generates steam for this large sanitarium tells you that it is a model of efficiency. The two 400 H.P. 3-drum, bent tube boilers call for steady firing . . . and "F & E" direct steam drive stokers more than meet this requirement. Burning low-cost fuel, they make this an exceedingly economical installation.

This "F & E" Stoker installation is just one of many hundreds of installations that are turning in outstanding performances in industrial plants, public buildings, hotels, schools, housing projects and institutions the country over.

So, if you're planning new boiler room equipment, for now or postwar, have your consulting engineer get the facts on "F & E" Stokers from the "F & E" representative in your territory. He can give you facts that will amaze you.

ONLY "F & E" STOKERS HAVE ALL 6 OF THESE IMPORTANT FEATURES

1. Choice of Direct Steam or "F & E" Electro-Hydraulic Drive.
2. Patented "F & E" Interval Timer Governor for perfect control of fuel feeding rates.
3. Sliding Bottom Retort for even fuel distribution.
4. Exterior Fuel Bed Regulator.
5. Removable Ram Case Liner.
6. High Efficiency Tuyeres of heat-resisting metal.

F&E

UNDERFEED STOKERS

for boilers producing from 1,000 to 40,000 lbs. of steam per hour

are manufactured by

FLYNN & EMRICH CO.

Established 1842

HOLLIDAY & SARATOGA STREETS, BALTIMORE 2, MARYLAND

Representatives in Principal Cities

MASTERY OVER SCALE

with AIRETOOL TUBE CLEANERS

Scaling of tubes cannot be eliminated, but scale can be removed quickly at a saving of time, tubes and money through the use of Airetool Tube Cleaners. Airetool's new form cutters prevent tracking when properly used—and will not damage tubes. Airetool's more powerful motor develops 28% greater power and may be loaded down to 50 rpm without stalling. Long lived Airetool Cleaners are available for tubes ½" to 24" I.D.—either straight or bent; air, steam or water driven.

Tell Airetool Engineers your tube cleaning problems. They will gladly advise you without obligation. Write Dept. PY today for details.

TUBE EXPANDERS

Precision made, long lasting Tube Expanders are made by Airetool in a variety of sizes to meet every tube expansion and rolling problem.

Write Dept. PY for new booklet

AIRETOOL MANUFACTURING COMPANY

Airetool & Yost-Superior Factory Bldgs.

SPRINGFIELD, OHIO

You Get CLEAN STEAM With

MAGIC BOILER PRESERVATIVE

—WON'T EVAPORATE OR DISTILL OVER

"MAGIC" Boiler Preservative has the big advantage of being non-volatile. It will not evaporate or distill over with the steam.

The steam from boilers using "MAGIC" is pure and free from any chemicals or injurious gases. It can be used directly in processing industries without injury to products.

Remember, too, that "MAGIC" puts a protective film on the iron which not only prevents scale from adhering, but also helps to prevent pitting, corrosion and leaks.

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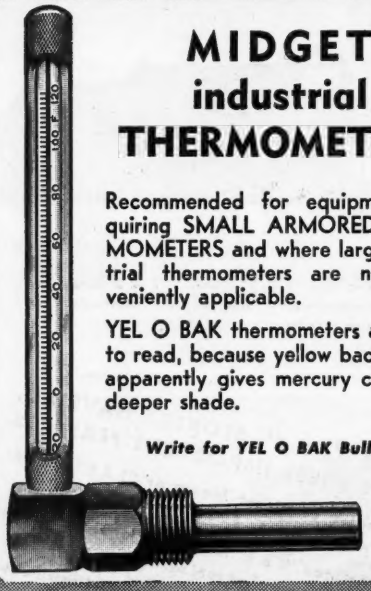

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YEL O BAK thermometers are easy to read, because yellow background apparently gives mercury column a deeper shade.

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EROSIVE CORROSIVE INFLAMMABLE LIQUIDS & GASES

As the Grove Flexflo Remote Control Valve employs just one *(non-metallic)* moving part, it is especially suited for handling erosive, corrosive and inflammable fluids and gases. Its flexible synthetic tube expands to open and contracts to close by remote control. Therefore there is never the slightest possibility of damage, hang-up or injury resulting from the transmission of fluids containing sand, scale, cuttings or other fine solid particles. Abrasive wear is automatically compensated for, by the contractile elasticity of the flexive sleeve. Lithgow coating of inner surfaces of valve permits the handling of highly corrosive liquids and gases. Line fluid is completely sealed off from operating medium thereby eliminating the troublesome and dangerous hazards of stuffing boxes and exposed members. Clean sources of external operating fluid remove all problems of remote operation. Write for complete details today—ask for Bulletin 800.

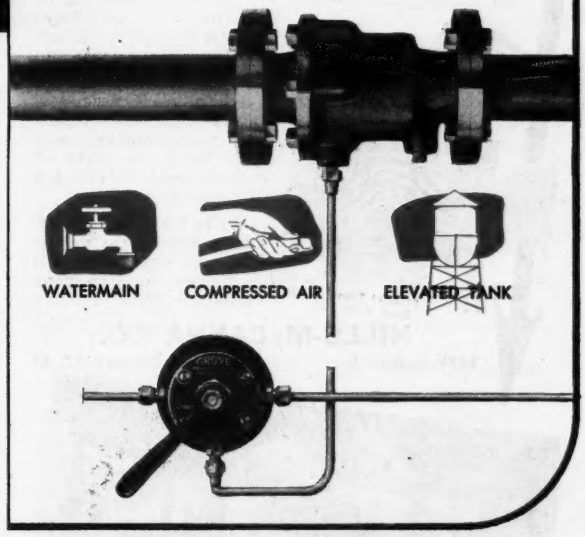
- *Especially suited for frequent cycle operations*
- *Provides positive timing control of opening and closing*
- *Extremely resistant to corrosion and erosion*
- *Automatically self compensating for wear*
- *Insures positive bubble-tight, leak-proof shutoff*
- *Smooth non-turbulent streamline flow*
- *Avoids surges and line shocks*
- *Impossible to hang-up, stick or freeze*
- *Eliminates overhead chains, extensions and costly motorized equipment*

THE ORIGINAL EXPANSIBLE TUBE TYPE VALVE

EXPANDS TO OPEN

CONTRACTS TO CLOSE

...BY MEANS OF ANY *EXTERNAL* SOURCE OF FLUID PRESSURE SUPPLY



GROVE *Flexflo* REMOTE CONTROL VALVES

GROVE
SIMPLICITY
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GROVE REGULATOR COMPANY

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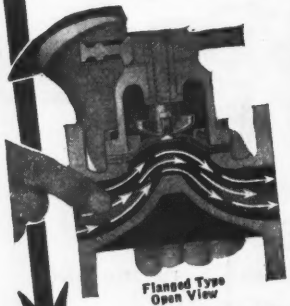
VALVES HANDLING *Dilute Sulphuric Acid* IN POWER PLANT

ANOTHER INSTANCE OF HILLS-McCANNA SAUNDERS PATENT VALVE DEPENDABILITY IN TOUGH SERVICE . . .

It's the Construction That Does It!

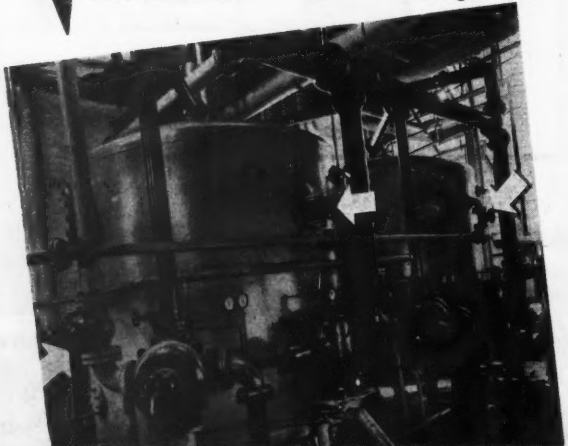
With Hills-McCanna Valves there's nothing to go wrong. The operating mechanism is completely isolated from the flow line. No metal-to-metal seats, no packing, no scoring, wire-drawing, freezing or sticking . . . sure-tight closure even over foreign matter . . . no leaks, no drips, no corrosion.



All the weaknesses and faults—expensive repair and replacements — and maintenance costs of conventional valves are eliminated.

Write for Catalog V-44. Learn how these valves will save you trouble and shut-down time on your vital pipe lines.

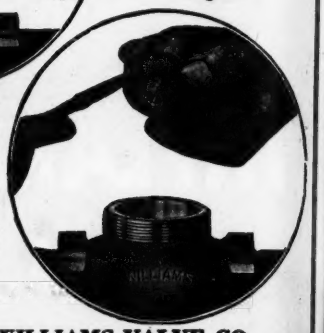
HILLS-McCANNA CO.
2439 Nelson St. • Chicago 18, Ill.



Hills-McCanna Valves on Dilute Sulphuric Acid lines in connection with Graver Zeolite Water Filters used in conditioning boiler feed water in power plant of a large East Chicago, Indiana refinery.

Use **VULCODISC** *for trouble-free valve jobs*

In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.



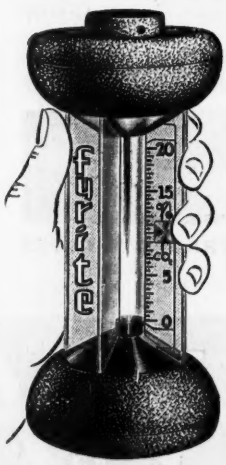
Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder. Write for descriptive bulletin.

THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

COOPERATE with the NATIONAL FUEL EFFICIENCY PROGRAM **TO SAVE VITAL WAR FUELS**

USE THE **PRACTICAL FYRITE CO_2 INDICATOR**

REVEALS FUEL WASTE *INSTANTLY!*



$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

CO_2 analysis of the flue gases is the only method available for determining the percentage of fuel wasted up the stack. The practical FYRITE CO_2 Indicator makes accurate flue gas tests easy—quickly pointing the way to adjustments and repairs necessary to secure efficient fuel utilization. The FYRITE requires no skill or technical knowledge; is simple and rugged; has no valves, clamps, or leveling bottle, no glass parts or batteries.

OXYGEN INDICATOR designed on same principle available soon. Write for particulars.

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RETURN THIS COUPON FOR BULLETIN 341 on FYRITE. *Learn how to get immediate delivery under priority regulations.*

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d Tile With Their Intermeshed Treads Small Size Stand the Strain of High nperatures Better and Provide Longer Life for Furnace Enclosures.

Here is visual proof of the soundness of one of Detrick's construction principles, namely: small sized tile suspended, hand-ed and intermeshed. The photograph shows an arch in which both large tile and Detred Tile were used for the same period, under the same service conditions. Note that the larger sized tile are in most cases split and are spalling badly. The Detred area is sound and tight.

In thousands of furnaces and other heat enclosures throughout the country the soundness of Detrick engineering has been proved by the way the arches and walls have stood up under the extra over-capacity operation of war effort. It is when extra severe service is needed that the thirty years of Detrick engineering experience shows up best.

Anticipate Post-War Needs Now

It won't be long before we will all be looking for post-war business, and the wise ones are avoiding the rush. If you have plans for modernizing your present equipment or for the installation of new boilers or furnaces, send your print and let our engineering department make suggestions. In the meantime ask for a copy of our 80-page catalog entitled DETRICK FURNACE ENCLOSURES which will bring you up to date on this most important subject.

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USE DETRICK INSULATION . . . PLASTIC or BLOCK

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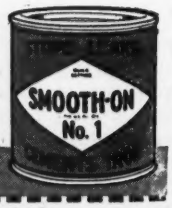
You can obtain Smooth-On from your supply house or, if necessary, from us. And be sure to mail the coupon before our limited supply of protractors is gone.



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MODERN GAGE VALVES for all Operating Requirements

TO HELP YOU KEEP BOILERS SAFE . . .

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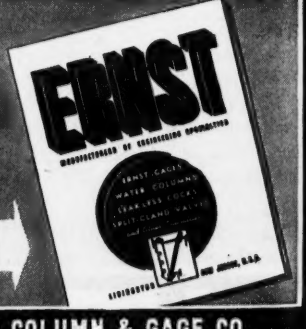

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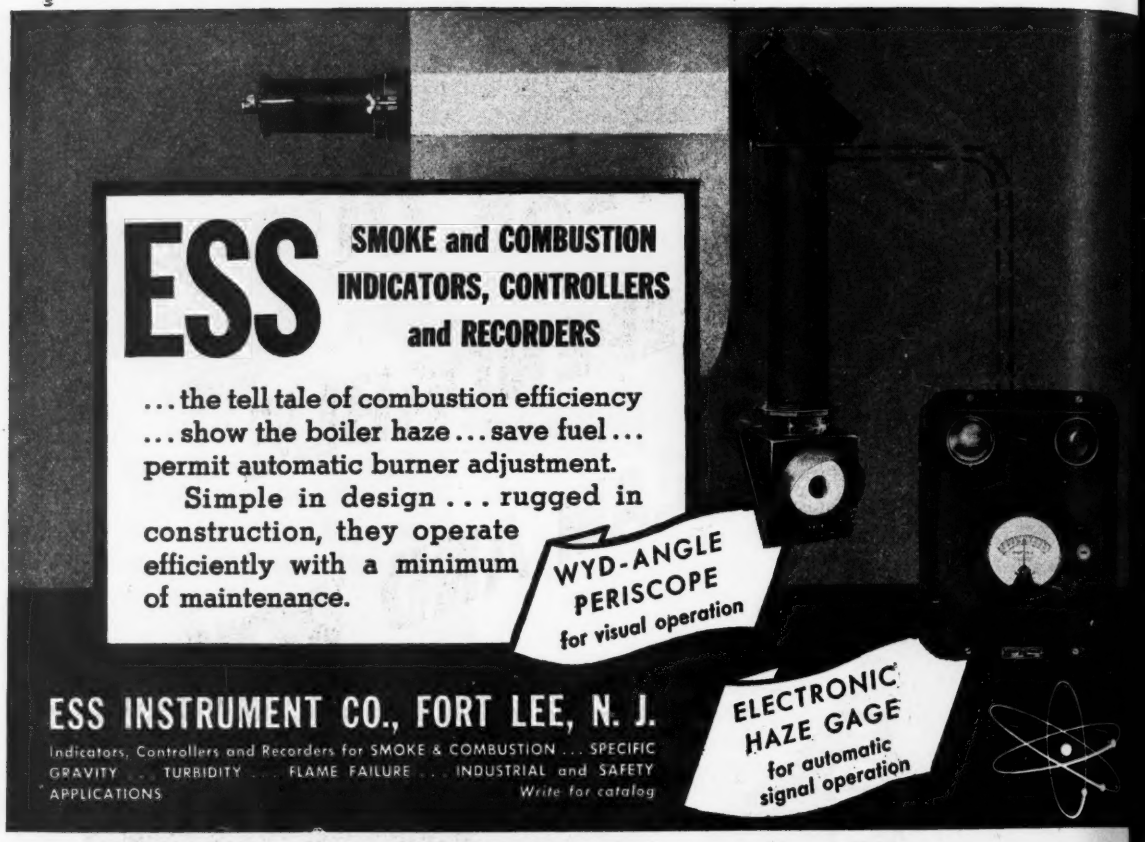

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... the tell tale of combustion efficiency ... show the boiler haze ... save fuel ... permit automatic burner adjustment.

Simple in design ... rugged in construction, they operate efficiently with a minimum of maintenance.

WYD-ANGLE PERISCOPE for visual operation

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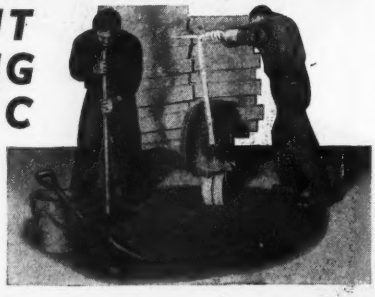
WITHOUT HALTING TRAFFIC



No longer is it necessary to close off an area of concrete floor while waiting for newly installed patches to set. Flexrock offers a new plastic repair material which is ready for traffic almost the moment it's put down.

Tamp Smooth! Truck Over Immediately!

There is no waiting. Simply shovel INSTANT-USE into the hole or rut—tamp—and your floor is restored to solid smoothness ... back in service without delay. Tough INSTANT-USE bonds tight to old concrete, makes long-lasting heavy duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

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Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.

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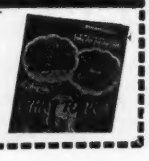

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With recent advancements in controlled turbulence, fly ash can be controlled at its source, your fuel bed.

Smoke is waste and can be regulated with important fuel savings.

Investigate the PERNET System of modern over fire air—applicable to all types of stokers including spreader or overfeed types.

Results proven in hundreds of installations in the field with important increases in boiler efficiencies.

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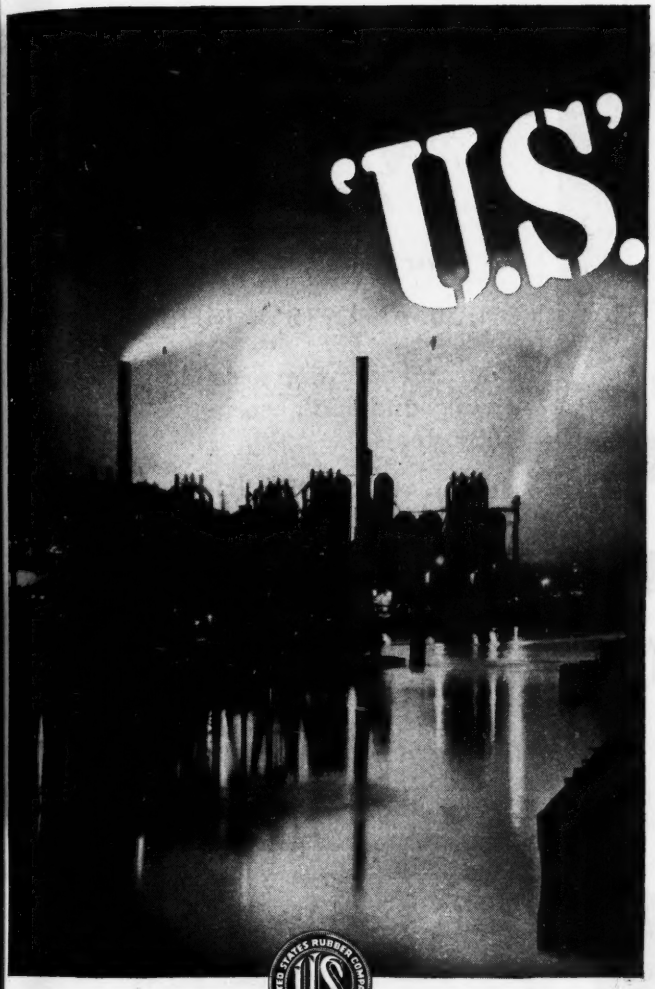

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A PACKING FAVORITE IN MODERN INDUSTRY

For long and continuous service on inside and outside packed pumps, maintenance engineers say there is nothing better than U. S. 573 Fine Hydraulic Packing.

Laminations of high quality duck—pre-tested for strength requirements are bonded together with a special compound, developed in "U. S." laboratories.

This special compound not only minimizes ply separation, but increases the packing's aging qualities. U. S. 573 is furnished in either regular or rock hard cure, depending on water temperatures encountered.

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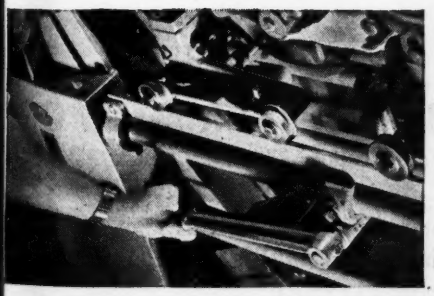
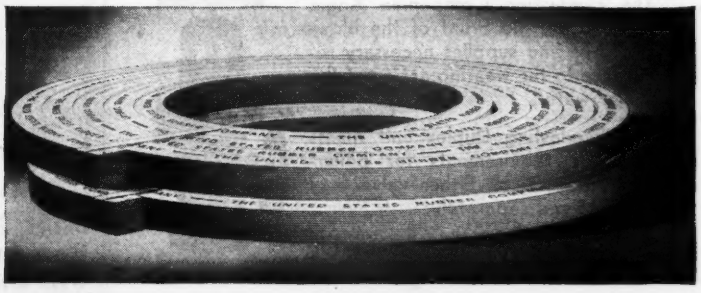


FABRIC TESTS—Service qualities of fabrics and other materials used in U. S. Hydraulic Packings are rigidly tested and must meet our strict factory specifications.



SIZES—From ¼ in. up—U. S. 573 Fine Hydraulic Piston Packings are furnished in coils and rings. Rings made with step, skive or butt joints. Orders should indicate which cure is desired—regular or rock hard.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

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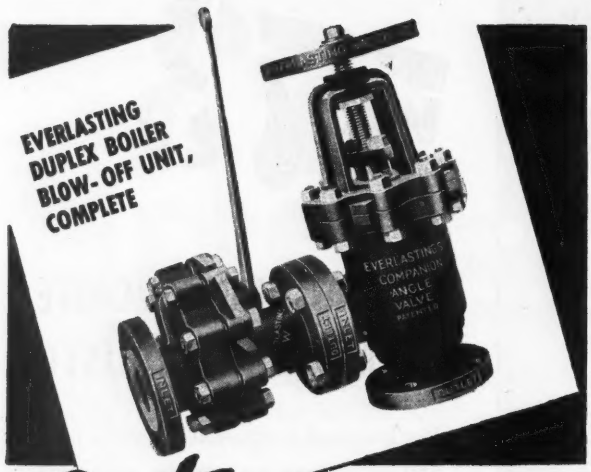


Get safe DUAL-VALVE BLOW-OFF CONTROL

Install an Everlasting Duplex Blow-Off Unit and you will be SURE of completely dependable valve teamwork. Quick opening and closing supplied by the "regular" Model W Everlasting lever-operated Valve . . . security completed by the wheel-operated Everlasting Companion Valve.

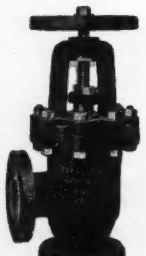
The Everlasting Valve opens with an easy 70-degree movement of the operating wrench; provides unimpeded straight-through flow; closes with the same ease and sureness. Each opening or closing action regrinds the disc, keeping it tight-fitting.

The sealing valve

The Everlasting Companion Angle Valve bears the brunt of the blow-off force and supplies necessary resistance to the wearing action of the boiler water.

The Everlasting Duplex unit meets all code requirements for boiler-blow-off service. Either valve may be obtained separately.

Write for Everlasting Bulletin E-100 giving full information.



The blowing valve

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for everlasting protection

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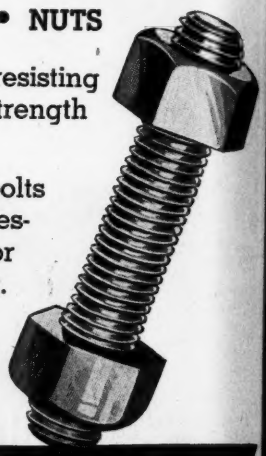

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When Injected with MANZEL CHEMICAL FEEDE

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Model CH-40

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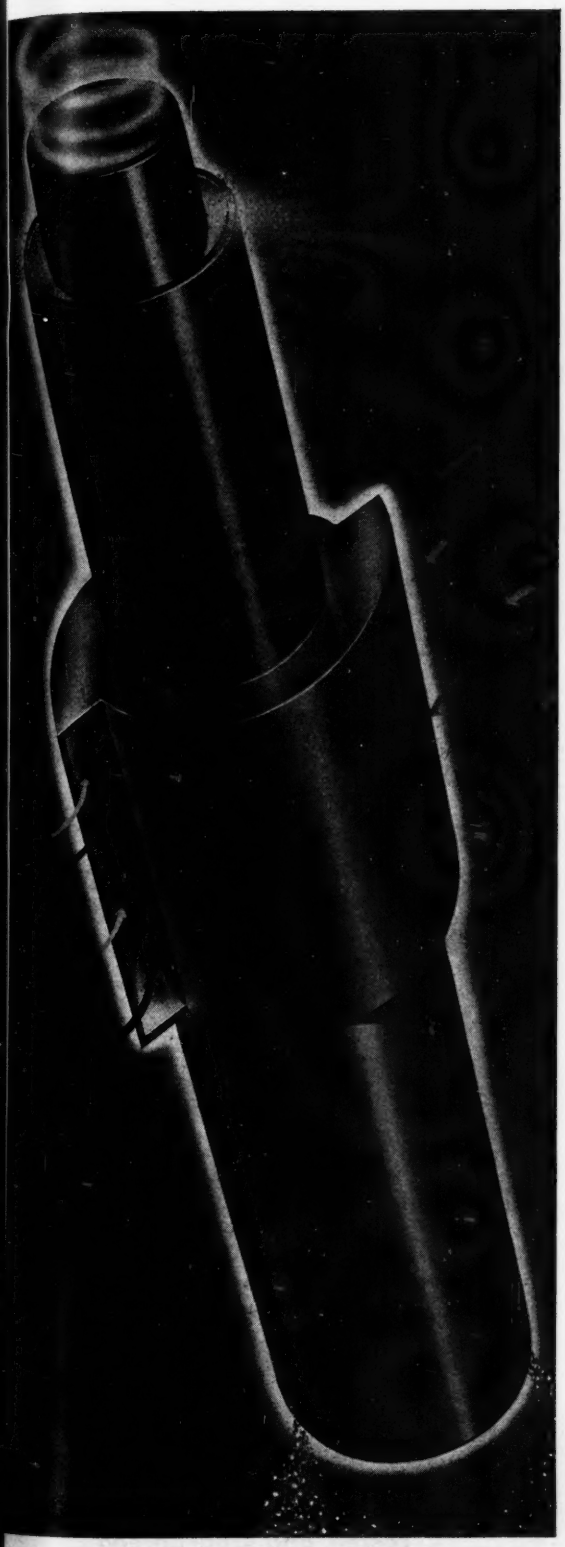

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DUST COLLECTION POSSIBLE

THE Duplex Dust Collector is like a double-barreled shotgun! "Why?"

Because it takes two barrels to get real results—the second barrel hits what the first one misses.

That, briefly, is the story of the new Thermix Duplex Collector. It combines *both* mechanical and electrostatic principles but its size is only slightly larger than the conventional mechanical units. And it *gets* results—94.66% *total* dust elimination, as proved by actual tests on extremely fine pulverized fuel dust! Dust escaping from this collector need never worry you even if dust ordinances and health requirements become increasingly severe. It solves your problem—economically—once and for all.

If desired, only the mechanical section of the Thermix-Duplex need be installed at the outset. Should greater efficiency be required, the secondary section can be added at any time. Furthermore, the Duplex is so designed that the mechanical unit *alone* will give high dust collection while the circuit of the electrostatic unit is being cleaned.

Write for bulletin giving engineering data.

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THERMIX ENGINEERING COMPANY

Project and Sales Engineers

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PRAT-DANIEL CORPORATION

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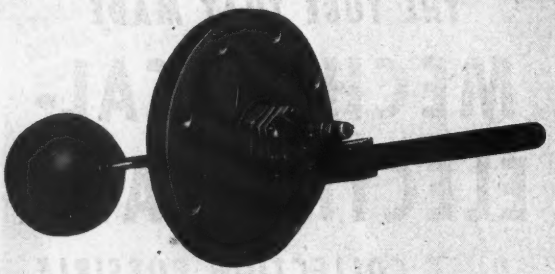
DAVIS LIQUID LEVEL CONTROLS

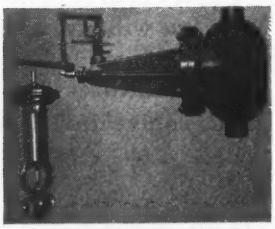
With Dia-Ball Packless Transmission Unit



A Packless, Leakproof Transmission Unit for Liquid Level Controlers and Control Valves

No. 161D Packless Float Box and No. 66B Packless Control Valve.

No. 164D Packless Float Box with Explosion Proof Switch and No. 975H Solenoid Valve with Explosion Proof Solenoid Case.



No. 162D Packless Float Box with Pilot Valve and No. 14 Diaphragm Motor Valve.

- **REPLACES** conventional outboard ball bearing packing box.
- **SAVES** time and maintenance nuisance for busy engineers. No leaky shaft or stem packing with which to contend; no packing box nuts that need be taken up.
- **PROTECTS** against danger of inflammable or volatile liquids leaking and causing fire or explosion.
- **IMPROVES** control operation throughout straightlined power transmission, minimum of friction, and increased sensitivity. For pressures up to 300 p.s.i. and temperatures up to 300° F.
- **AVAILABLE** on Davis Liquid Level Controllers, Lever Operated and Solenoid valves.

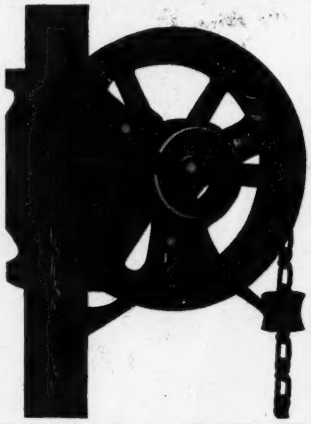
For complete details write for literature.

DAVIS REGULATOR COMPANY

2508 S. Washtenaw Ave. **Chicago, Illinois**

DAVIS REGULATOR COMPANY

Do Away with Dangerous LADDER WORK



Stop climbing ladders to open and close those "high-up" valves. Equip them with Babbitt Sprocket Rims and you can control them quickly and safely from the floor. Babbitt Rims are easily attached and low in cost. They show real savings in time and steam—help guard against accidents. Now is the time to fit your overhead valves with Babbitt Rims. Write today for further information.

BABBITT STEAM SPECIALTY CO.

South Water, Spring and First Sts.,
New Bedford, Mass., U. S. A.

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

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ALSO FITTINGS

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FOR NEW IDEAS

on production . . .
operation . . . maintenance

Engineers and executives interested in the conservation and use of power can find help on up-to-the-minute methods and operating data, as well as new developments and new products at the coming 16th National Exposition of Power and Mechanical Engineering. There, a display of tested, practical ideas, will help develop the more effective utilization of the Nation's power resources.

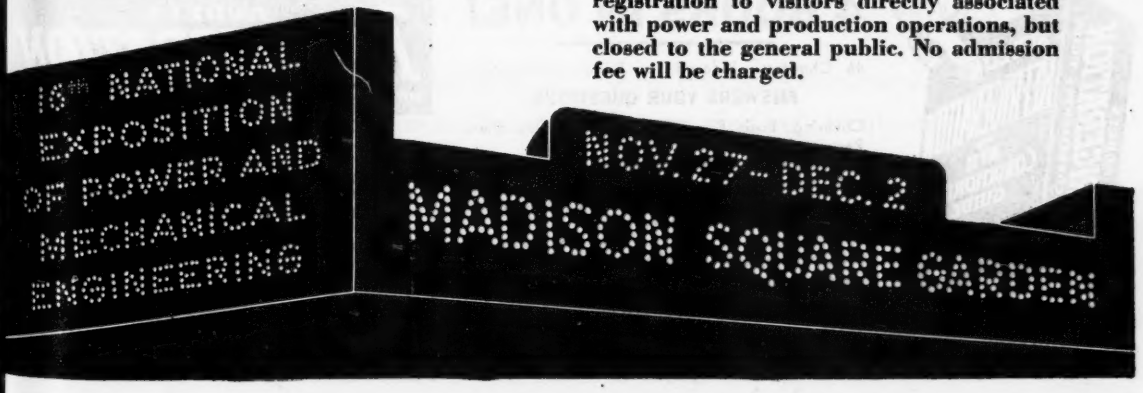
Engineering specialists in attendance at the numerous carefully-planned exhibits will give competent advice on the use and maintenance of products for use in the operation and maintenance of power plants. A display of tools for various power plant uses, will also be featured.

If you're thinking of tomorrow—as well as today—

This year's event will be keyed to the effective solution of continuing war production problems, particularly those caused by sudden shifts in military needs. At the same time, it will also provide informational sources for the advancement of your planning for the period of peace ahead.

You will obtain a first-hand response to your war and peacetime thinking at this show by seeing new products in operation—many of them for the first time. Here will be up-to-date information on power plant applications—products of wartime development and improvement. The 1944 Power Show is an opportunity for you to crystallize your thinking and planning for tomorrow, as well as today.

Plan to attend with as many of your associates as can be benefited. As in the past, the Exposition will be open by invitation and registration to visitors directly associated with power and production operations, but closed to the general public. No admission fee will be charged.



THIS WAS A MIGHTY MAN-O-WAR

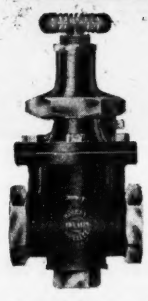
Launched in 1886, the Chicago *was ultra-modern in her day. Her armament included 5", 6" and 8" guns, 12 rapid fire guns, and 1 "breech-loading rifle." She was 4500 tons; developed 5084 HP.*

There were only 38 states in the Union the year the *Chicago* was launched. Telephones were a novelty; electric light a new-born experiment. But no longer experimental was the K & M Steam Trap. Introduced in 1879, it was a good trap—the "daddy" of all traps.

This is K & M's 64th year devoted exclusively to designing and building steam specialties and controls. In World Wars I and II we have earned citations from the government. In wartime and in peace we have earned the endorsement of American industry.

The cumulative experience of our 64 years is clearly evident in the fine valves and traps we manufacture today. For instance, type 481 A, the very compact pressure reducing valve for inlet pressures to 250 lbs., and reduced pressures of 2 lbs., to 80% of inlet. Type 481, similar, is self-contained; requires no control line.

The factory-trained K & M representative in your territory will be glad to discuss with you the applications of these or any other of the more than 100 K & M valves, traps and controls. Write for General Catalog 66.



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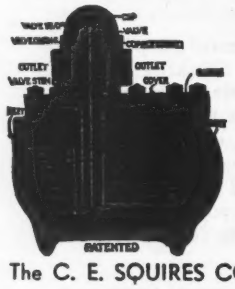

saves your fuel bill as it operates **without** loss of steam.

May we send Catalog E-9 giving complete information.

The C. E. SQUIRES CO., Cleveland, O.

Care-Free Maintenance

of water level in your heaters, tanks, reservoirs and other equipment avoids a lot of operating headaches in these days of peak production and man-power shortage. Hercules Seamless Copper Floats have been doing that kind of job for 50 years. With 666,000 of them now in service, each sold under a full year's guarantee, we know what they've done, what they will continue to do. If **you** don't know, it will pay you to find out by putting a few of them to work in **your** plant.

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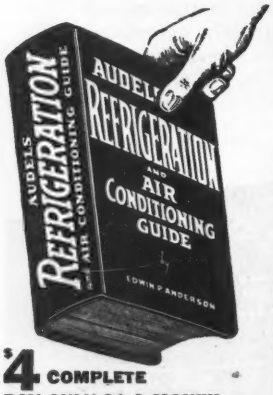

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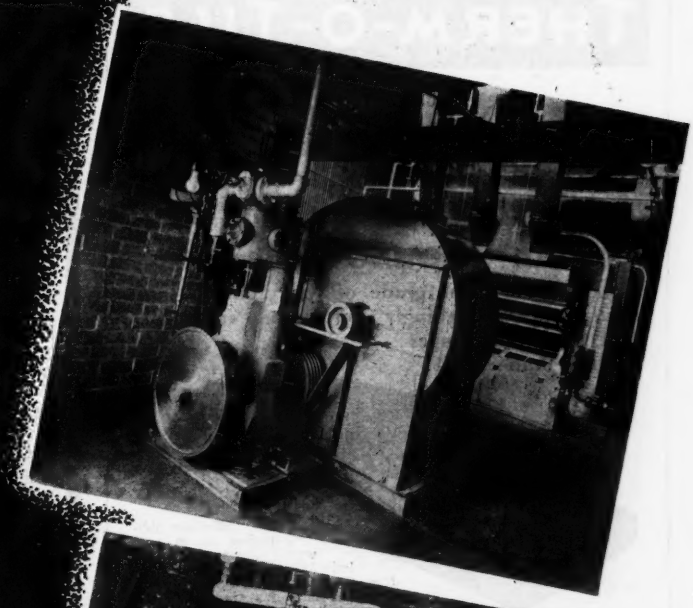

THERE is heat PLUS power in steam. When you use live steam for heating and processing purposes only, the power may be going to waste . . . costly waste.

Use both the power as well as the heat in your heating or processing steam by installing a Troy-Engberg Steam Engine.

You will have a dependable drive for stoker, blower, pump, compressor, or other equipment, and the exhaust at low pressure will provide effective heat.

Are engines economical? Troy-Engberg Steam Engines frequently write themselves off within two years, sometimes one.

TROY ENGINE & MACHINE CO.

Established 1870

868 RAILROAD AVENUE **TROY, PENNSYLVANIA**

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THERM-O-TILE

This

Underground Pipe Conduit

is equipped with a

"SPREAD FOOTING" Foundation

Hence it holds the grade of the piping *permanently* — an exceedingly important advantage. For other advantages ask for Bulletin 381.

Without obligating us in any way, ☐ Please send Bulletin 381. ☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective underground piping job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Clip your name, firm, and address to this ad; tear out with the checked squares above; mail; and you will hear from us promptly.

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FOR ALL TYPES OF BOILERS

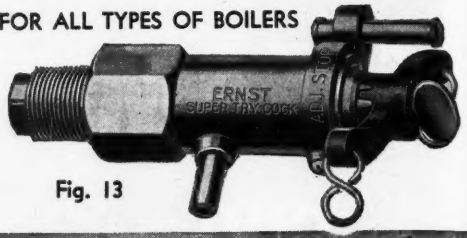

Fig. 13

TO HELP YOU KEEP BOILERS SAFE . . .

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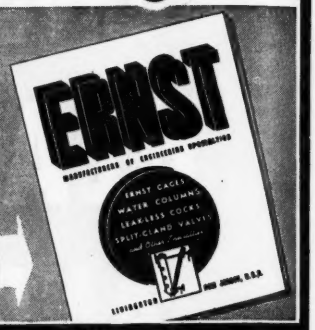

ERNST WATER COLUMN & GAGE CO.

LIVINGSTON, NEW JERSEY

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Paper vests have proved excellent for aviators and ground crews as cold protection.

Paper is used for disposable gun covers and ordnance wraps to protect such equipment while making invasion landings.

The Army supplies helmets of laminated fiber for non-combat duty in the tropics.

Many essential airplane parts are fabricated of plastic with a paper base.

Army trucks require 20 pounds of paper for safe delivery.

It takes 25 tons of blueprint paper to make a battleship.

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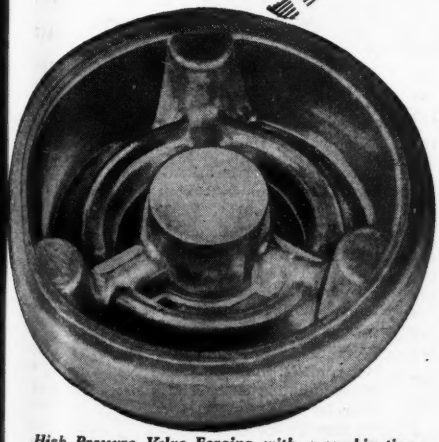
This advertisement prepared under the auspices of the War Advisory Council in co-operation with the Office of War Information and the War Production Board. Space contributed by POWER PLANT ENGINEERING.

★ AVOID USELESS WRAPPINGS! ★ ACCEPT SIMPLER PACKAGING! ★
PAPER
PACKS A WAR
PUNCH!
FIGHT WASTE!
★ SHARE THE PRINTED WORD! ★ MAKE EACH PIECE STRETCH!

One purpose • • •

the IMPROVEMENT of Metals

by Forging



High Pressure Valve Forging with a combination of bosses and depressions in the forging of which the metal has been distributed so as to completely fill out all sections of the forging to close tolerances.

Parts operating under complex stresses and high pressures require metal quality developed to its maximum. Whatever the shape, size, weight, or design of a part, the primary objective of the IMPROVEMENT OF METALS BY FORGING is always to develop fully the metal quality which a specific grade of metal affords. Complexity of design should involve no compromise with quality, for strength and toughness are vital to all stressed parts. Holes, deep depressions, and recesses require unusually skillful die design and forging craftsmanship to hot work the metal throughout the full depth of the wall sections forming a hole or a pocket. Throughout 31 years of forging production experience, our engineers have succeeded in making many so-called impossible-to-forge designs, thereby effecting marked improvements in many products. Ask one of our forging engineers to show you how forgings improve product performance.

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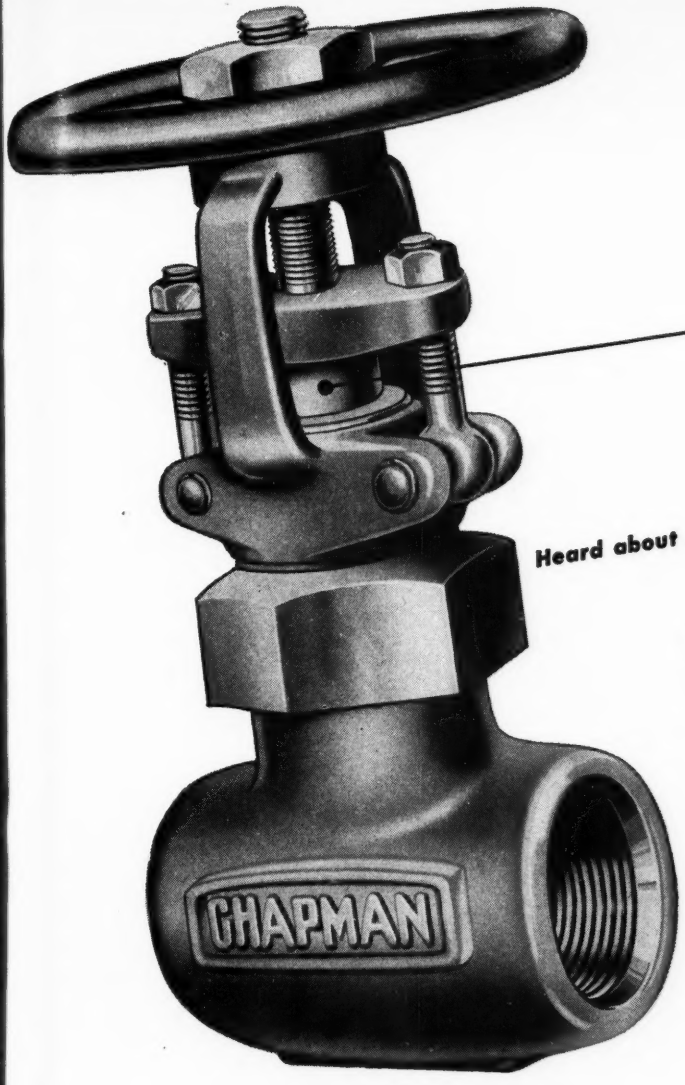
Yeomans Bros. ..... *
Young Radiator Co. ..... *
Youngstown Miller Co.. The ..... *

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *



Heard about Chapman's new List 960 gate valve ?

It's replacing Chapman's standard List 960 small forged steel gate valve of the rising outside screw type, and is designed to give even longer service. And here's why:

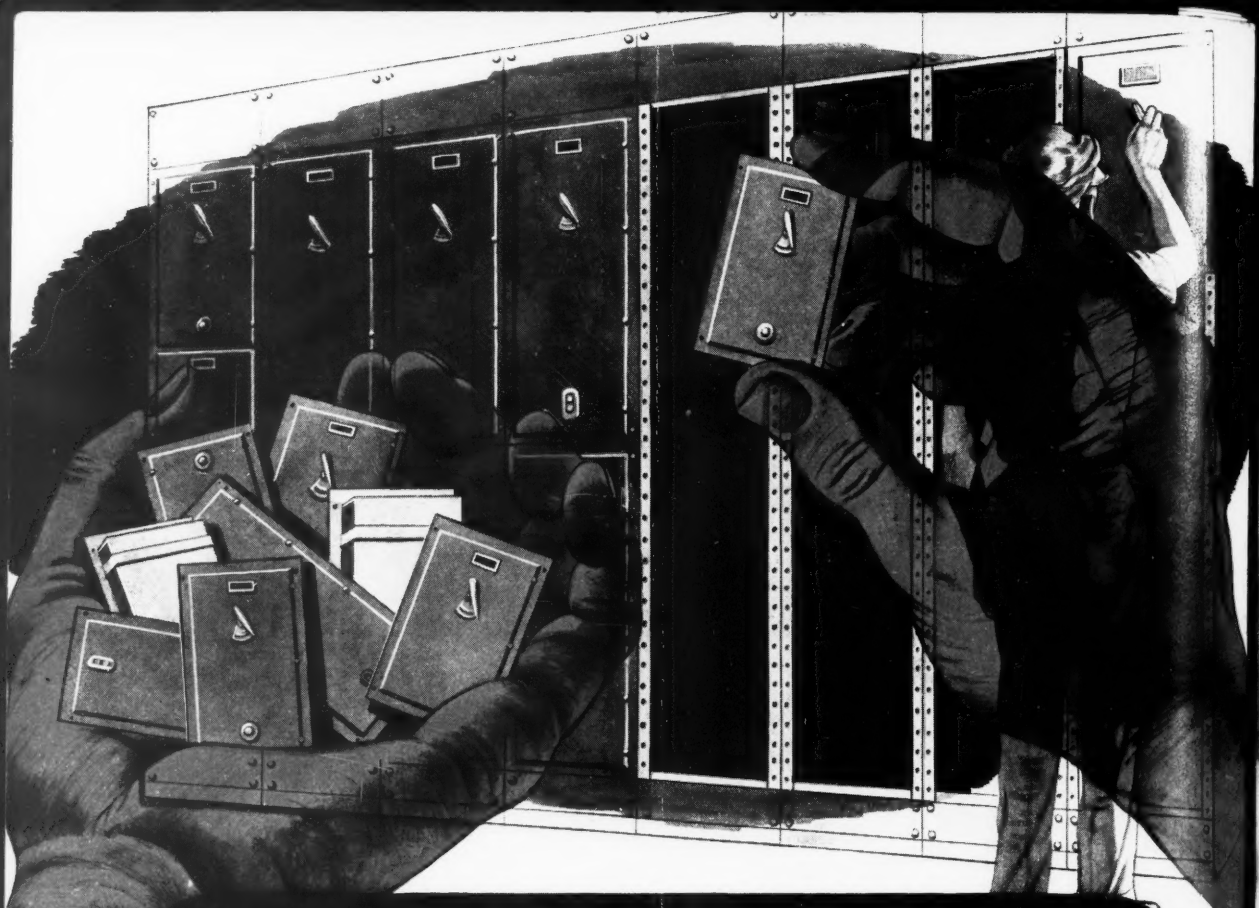
- Bonnet now fitted with a substantial forged steel yoke. A flanged forged steel packing gland is provided, thereby eliminating exposed threading on valve yoke, thus giving immunity from rusting and corrosion when placed in exposed locations.
- Stems, plugs, and seat rings *on all valves* are heat treated stainless steel to insure greater working qualities.
- Swivel bolts are used for holding the packing gland.
- No gaskets to blow, as in valves with flanged bonnet connections.

Specify List 960 outside screw type in carbon steel for working pressures to 800 lbs. at 750° F. Or in alloy steel for service at 1000 lbs. working pressure at 750° F. Both valves available in screw and welding ends. Where service conditions make it preferable the List 960 rising stem inside screw type is available.

For greater pressures — get Chapman *List 990* with heavier walls and extra strength. In sizes up to and including 1½", with screw or welding end.

LIST 960 PACKS IN MORE SERVICE!

The Chapman Valve Mfg. Co., Indian Orchard, Mass.



TO SAVE TIME, MANPOWER, SPACE, *TODAY and TOMORROW*...USE UNITROL

The Filing Cabinet Idea applied to motor control

1. Skeleton Starter

Unitrol is built up in much the same way as the familiar filing cabinet system.

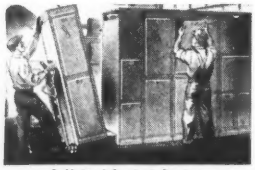
The skeleton starter or switch (see photo No. 1 at left) is fitted into a frame with a door in front (see photo No. 2 below).

2. Unitrol Door Frame

This Unitrol "unit" is fitted into a section (see photo No. 3) and sections are placed side by side, as many as you want as in sketch at bottom.

Like your filing cabinet system, the contents of each "drawer" are easily changed or placed in other "drawers". Sections can be rearranged, moved elsewhere, or new ones added. Unitrol is the flexible, versatile system of housing motor control for all time, ready at any time to meet all needs. You should investigate it today.

3. Unitrol Section



4. Unitrol Control Center

You can begin any time to put in UNITROL, the *better* way to house, install and systematize motor control. If you are buying control for new machines, ask for it in Unitrol. Then you won't have to spend time and manpower on wall or floor preparation. Unitrol can be placed anywhere in the plant ready for work the moment electrical connections are made.

If you are moving equipment around because of a production changeover, make it an opportunity to house the control in Unitrol. Then your inspection and service men can accomplish more because the control will be grouped in a compact Unitrol "center", convenient of access, easy to service, hard to overlook. Tremendous space savings result because Unitrol can accommodate 2 or 3 times as much control in equivalent floor space.

Unitrol is the modern method of housing control, ready made, ready for use, yet built to individual need from unitized, sectionalized members that you can add to, subtract from or rearrange with complete freedom. Many industrials, wanting to be *first* with the *right* answer for today and tomorrow, are swinging to Unitrol. For the facts behind the swing, write today for the big free Unitrol book. CUTLER-HAMMER, Inc., 1392 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ont.

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Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of th[illegible]it Serve